APRIL 18, 1955

Electrical World

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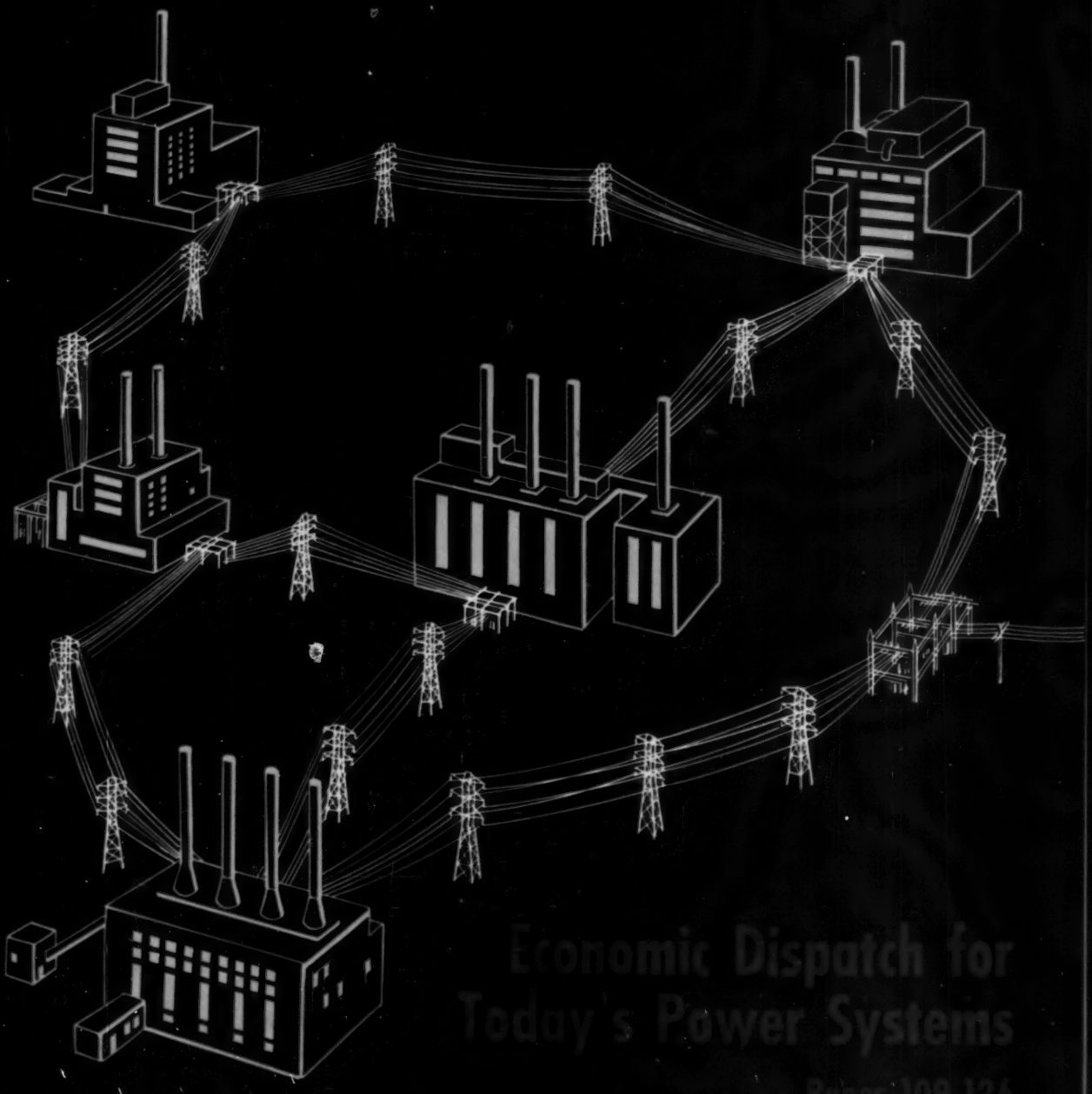

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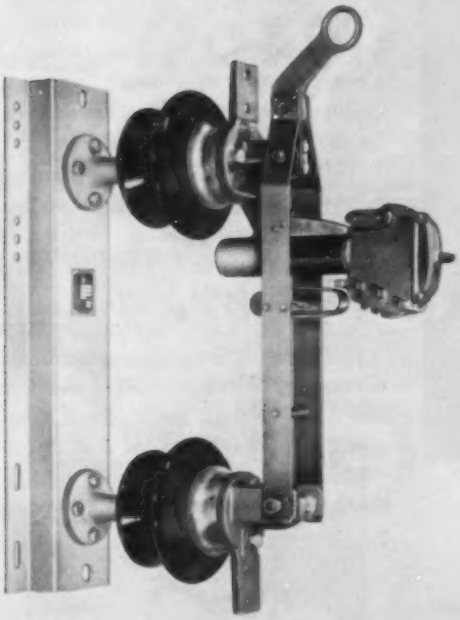

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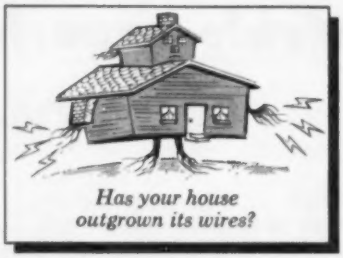

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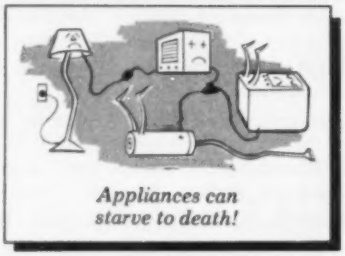

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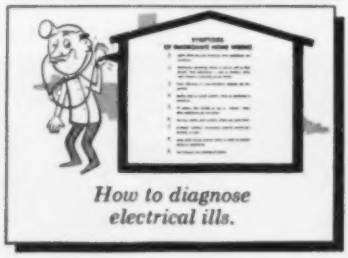

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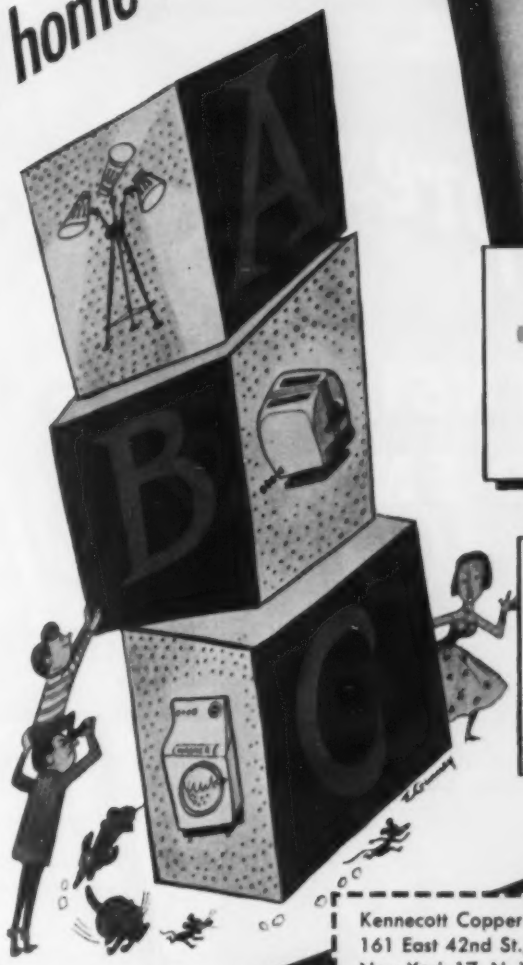

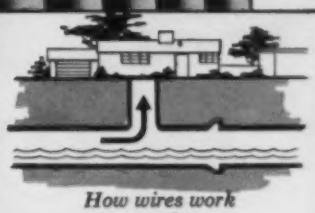

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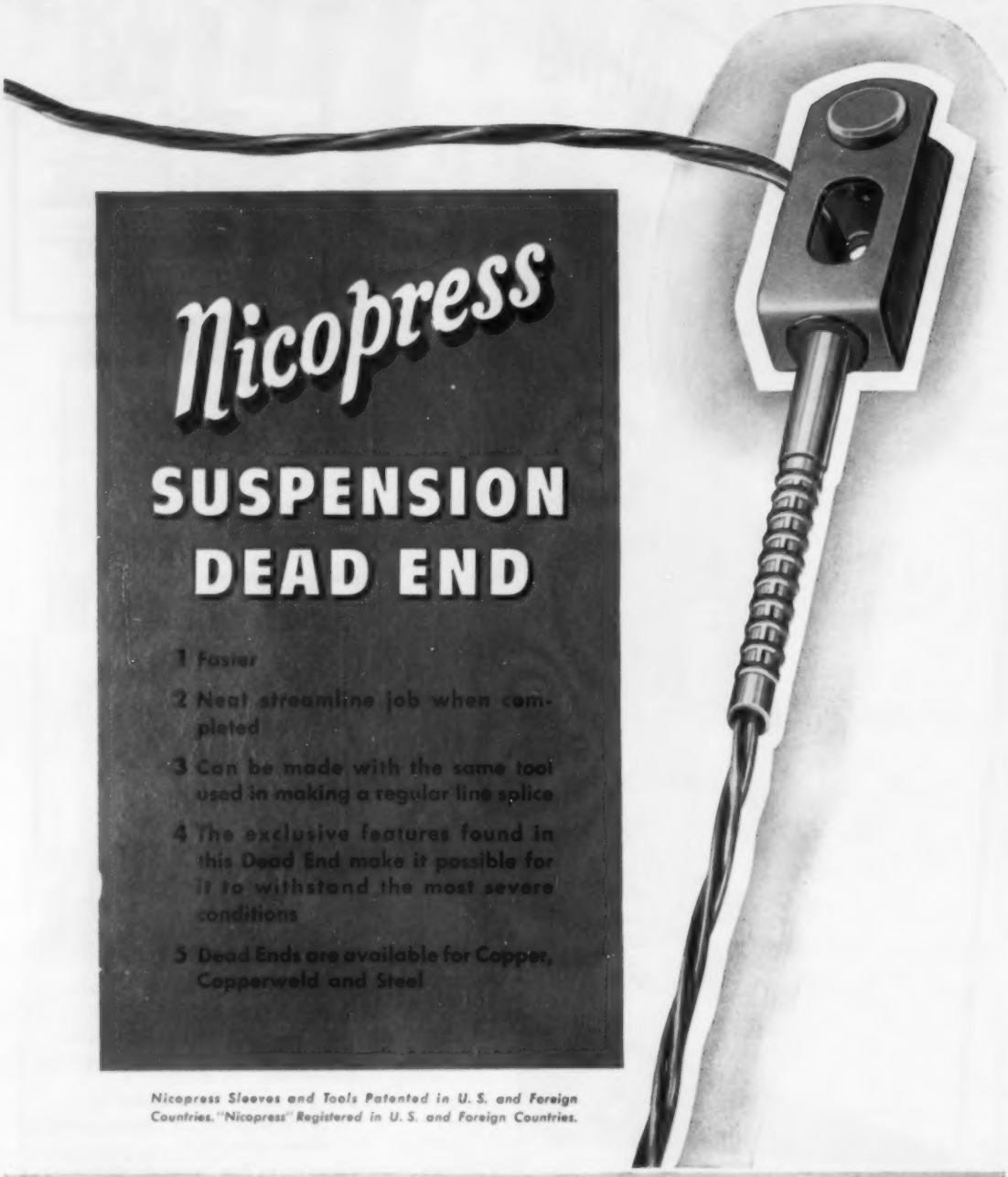

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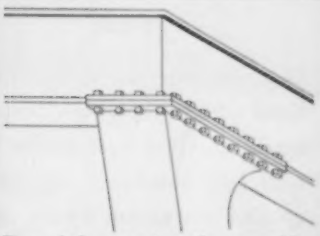

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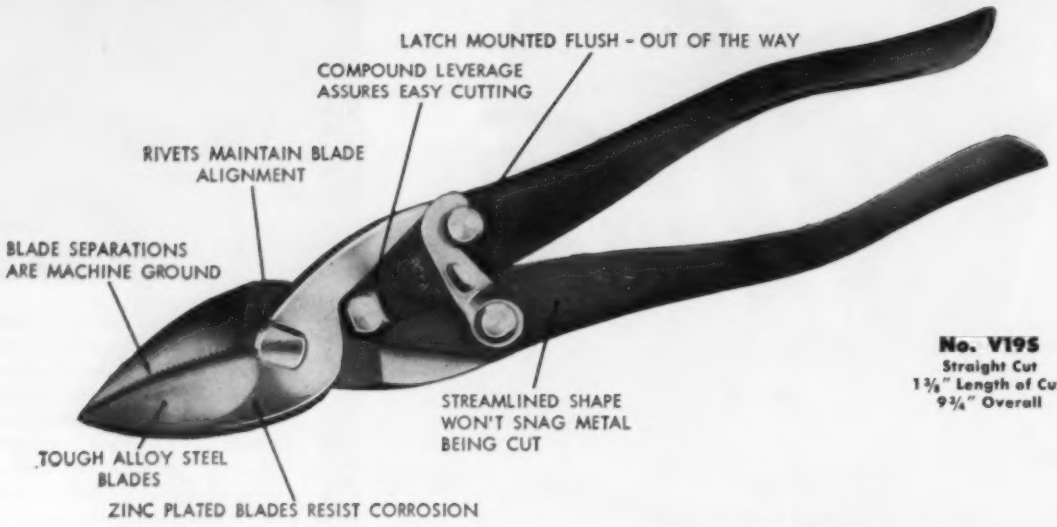
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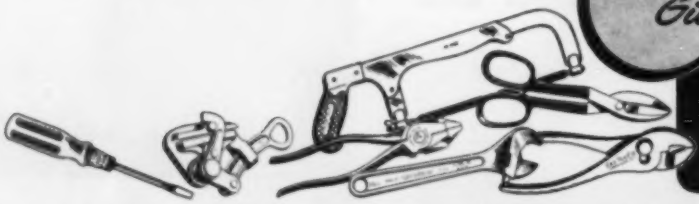

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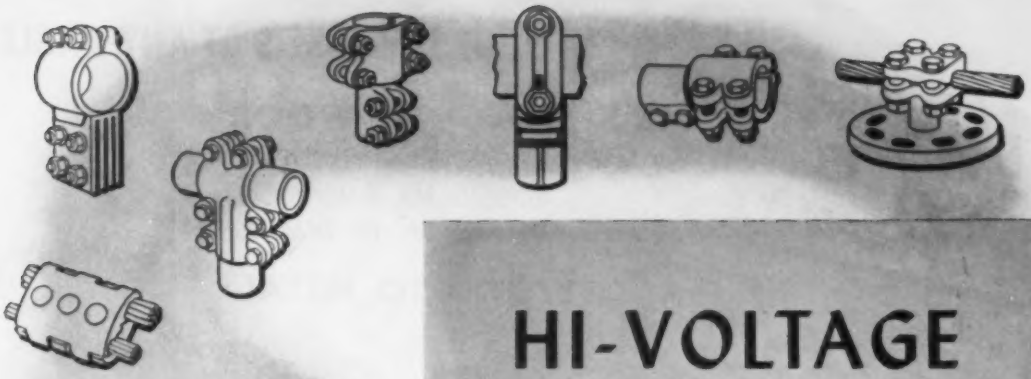

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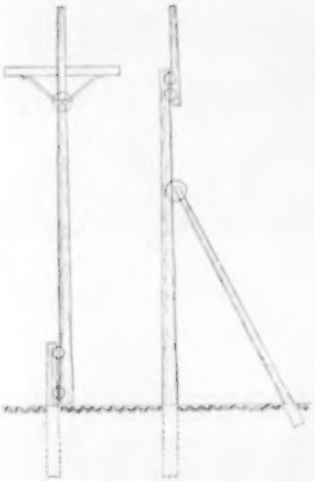
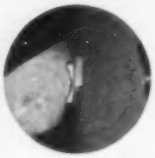
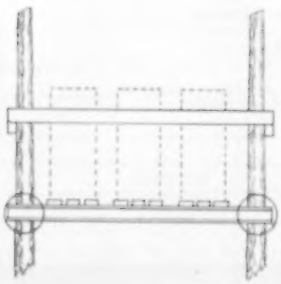
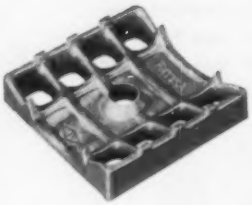








M.I.F. Grid Gains and Timber Connectors are adaptable to dozens of different applications — they make STRONGER, MORE DEPENDABLE CONNECTIONS.

Tests show that shear forces four to five times greater than could be resisted by a single through bolt are attained by using Grid Gains or Timber Connectors.

M.I.F. Grid Gains and Timber Connectors permit fuller utilization of the strength of wood by allowing higher design loads in shear — for both permanent and emergency construction. No special tools required for installation.

We have the story for you in our Bulletin PH10. Write us.

MALLEABLE IRON FITTINGS CO.

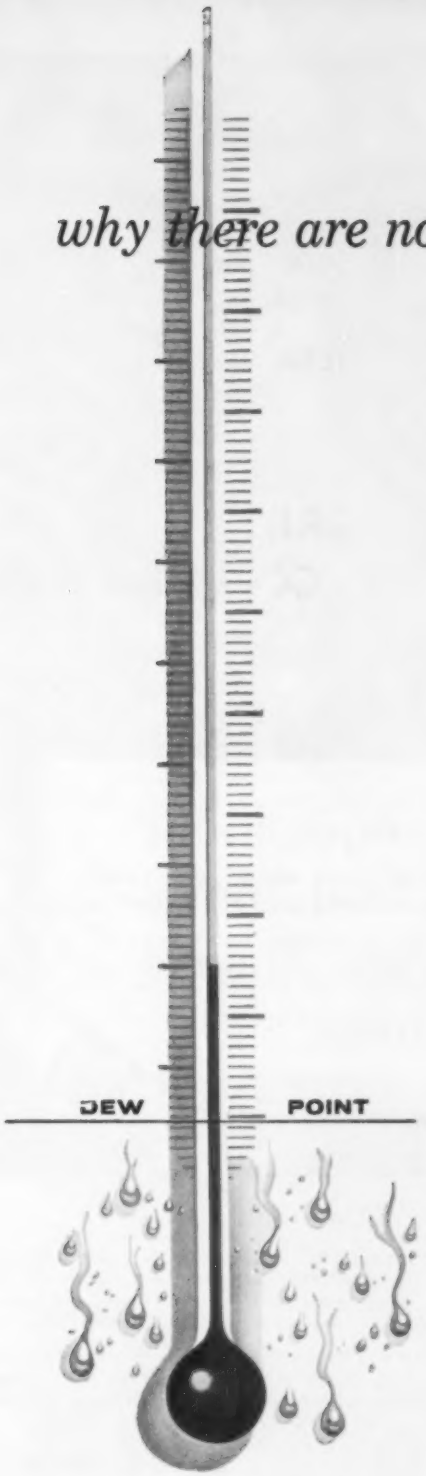
Pole Hardware Division **Branford, Connecticut**

N. Y. Office: 30 Church St.

Canadian Mfr. & Dist.: LINE & CABLE ACCESSORIES, Ltd. TORONTO

MIF

Representatives: William J. Cottrell Co., Portland, Ore. • James H. Drew Corp., Indianapolis, Ind. • Industrial Engr. & Equip. Corp., Los Angeles, Cal. • JSG Electric Co., Chicago, Ill., Lee-Smith Co., Miami, Fla. • B. H. McCoin, Knoxville, Tenn. • William J. O'Brien, Memphis, Tenn. • Robert P. Smith & Co., Jacksonville, Fla., E. A. Thornwell, Inc., Atlanta, Georgia • J. P. Voight, Summerville, S. C. • Waltham, DeWitt & Krusi, San Francisco, Calif. • L. G. Wendegatz, Kansas City, Mo. • Williamson Sales Co., Shreveport and New Orleans, La.; Dallas and Houston, Tex. • O. C. Witte Co., Detroit, Mich.



why there are no cold spots and less corrosion in the Ljungstrom® Air Preheater

In the Ljungstrom, the heat-transfer surface rotates alternately through the gas and the air streams . . . keeping heating elements consistently hotter than other types in equivalent service. That's why there are no cold spots . . . and less corrosion in the Ljungstrom.

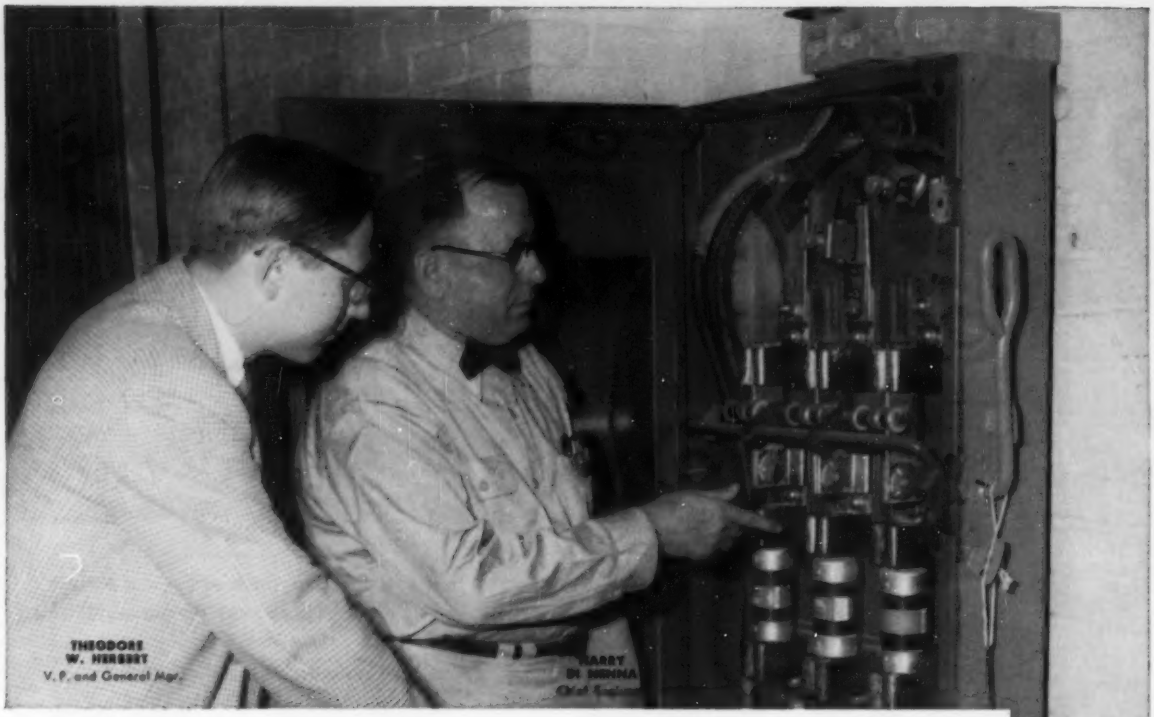
Even though corrosive action is slow, some does take place at the cold end of the Ljungstrom. This presents no problem, since the cold end is sectionalized to permit easy reversal and almost double life. Reversing or replacing the cold end does not disturb the rest of the elements and takes just a few hours.

Get all the details on the Ljungstrom Air Preheater. Send for the new, free, 38-page reference manual, "Ljungstrom Air Preheaters."

Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Reduces fuel consumption. Permits use of lower-grade fuels. Increases boiler output and reliability.
- Eliminates cold spots . . . keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



"We can now push our equipment 24 hours a day without fuse blows causing needless shutdowns, thanks to Fusetron *dual-element* Fuses."

"When we are on a tight schedule, we must operate 24 hours a day to fill our orders. Every piece of equipment in the plant is pushed to its limit. A work stoppage of any kind is more than annoying, it is most important as we just can't afford to waste time.

"We were using ordinary fuses to protect our motors, but these fuses couldn't hold up under the pressure. They would blow often and as I now know — needlessly.

"Every time a fuse blew we were losing money. I would start figuring how much harder and faster we would have to work to get back on schedule.

"Something had to be done. We called upon Mr. Paul Serotta of the Norristown Electric Supply Company. He recommended we discard our old fuses and replace them with Fusetron dual-element fuses.

"That was the answer all right. We can really notice the difference. Now, when we are on full production basis I am not worried that our equipment will be out of operation by the needless blowing of fuses."

Harry DiNenna
CHIEF ENGINEER
HERBERT HOSIERY COMPANY
NORRISTOWN, PA.

Play Safe! install Fusetron and BUSS Hi-Cap

Fusetron Fuses Do More Than Eliminate Shutdowns Caused By Needless Blows...

FUSETRON FUSES PROVIDE 10 POINT PROTECTION...

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnouts.

FUSETRON FUSES SAVE YOU Maintenance and Recalibration Costs

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

When a Fusetron fuse does open to protect, and after the fault has been corrected — the new Fusetron fuse you have installed has been *calibrated at the factory by engineers* — it is a fuse as safe and dependable as the one that blew.

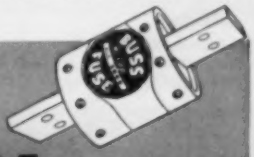
FUSETRON FUSES GIVE YOU GREATER SAFETY, BECAUSE OF THEIR HIGH INTERRUPTING CAPACITY

Tests verified by the Electrical Testing Laboratories of New York indicate that Fusetron fuses can interrupt safely the most severe available short-circuit current.

The tests circuits were set to deliver in excess of 100,000 amps. In each test the fuse cleared the circuit safely, the fuse remained intact, there was very little noise and cotton packed around the fuse was not ignited.

Yet there has been no interference with the time-lag characteristic of Fusetron fuses.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS., BUSS Hi-Cap FUSES PROVIDE...



Unlimited interrupting capacity to handle any fault current regardless of system growth! This was confirmed by tests witnessed and reported upon by the Electrical Testing Laboratories of New York.

Overload protection as well as short-circuit protection.

Coordination with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

On old installations, a safe and relatively inexpensive way to protect inadequate circuit breakers against rupture in event of bad fault.

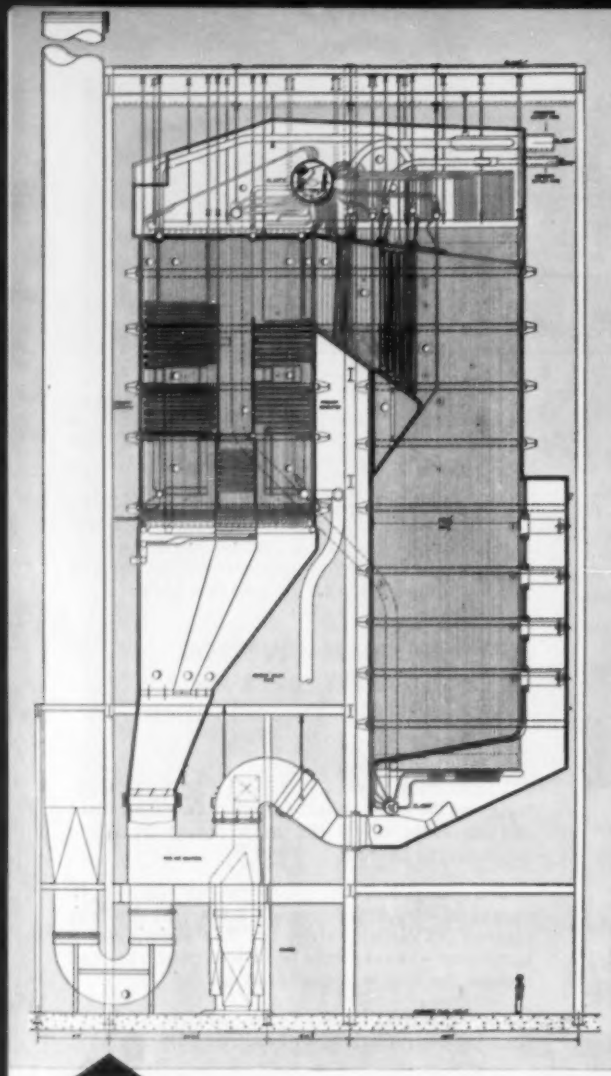
Dependable service through the years because there are no moving parts to stick or get out of order.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

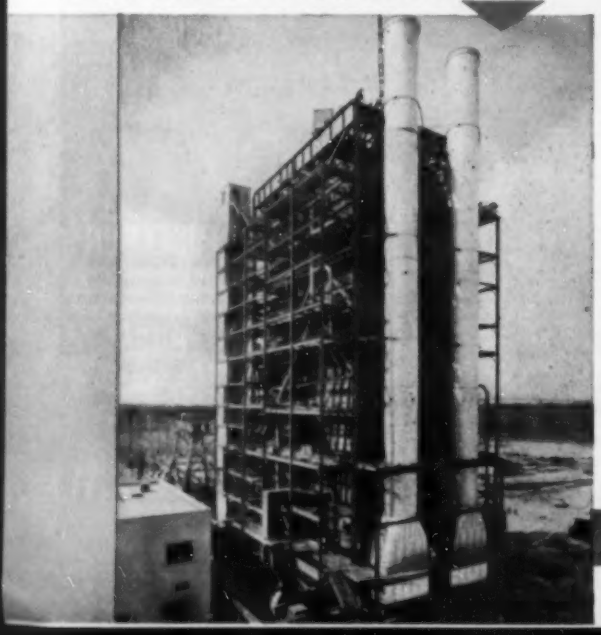
Blowing time charts and more information are available on FUSETRON Fuses and BUSS Hi-Cap fuses. Write for bulletin FIS and HCS.

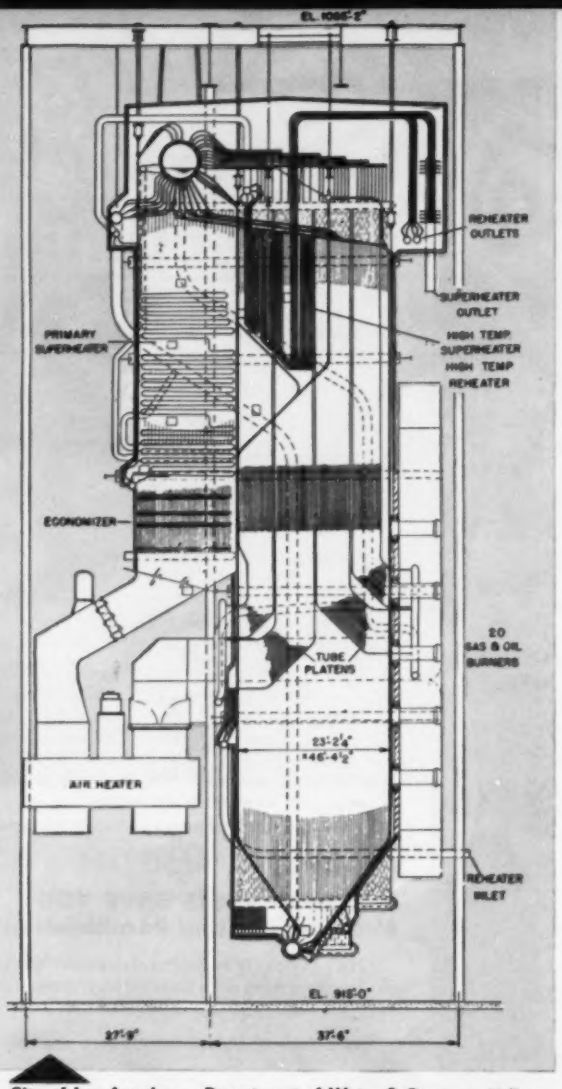
BUSSMANN MFG. CO., (Division of McGraw Electric Company) University at Jefferson, St. Louis 7, Mo.

Fuses throughout the entire Electrical System!



Louisiana Power & Light Co., Nine Mile Point Station — Ebasco Services, Consulting Engineers — 1-1,000,000 lbs/hr reheat unit with pressurized furnace — 1725 psig; 1005F/1005F Reheat.





City of Los Angeles — Department of Water & Power — Valley Steam Station 2-1,200,000 lbs/hr reheat units - 2075 psig; 1000F/1000F Reheat.

The acceptance of Riley for big reheat and pressurized units by the public utilities . . . the marked swing to Riley has been brought about by outstanding design characteristics such as those found in these three Riley units . . . low furnace exit temperatures through the use of radiant surface preventing objectionable slag formation; wide load range with stable ignition with damper or a combination of damper and spray control; high yearly net efficiency, dependability, and continuity of operation.

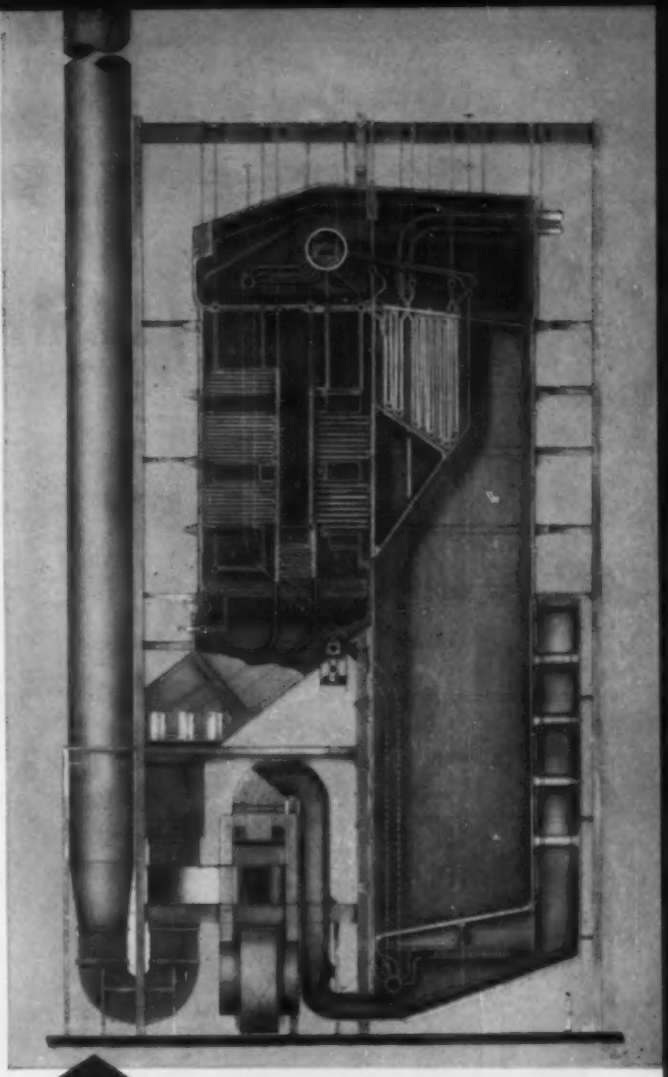
A survey of your power plant by your consulting engineer will possibly show ways of making surprising savings in your power costs. There is a Riley representative in all principal cities.

RILEY STOKER CORPORATION • Worcester, Mass.

COMPLETE STEAM GENERATING UNITS AND

for the BIG JOBS more and more public utilities

rely on



Houston Lighting & Power — Deepwater Station and Sam Bertron Steam Electric Station — Ebasco Services, Consulting Engineers — two 1,250,000 lbs/hr reheat units with pressurized furnaces — 2125 psig - 1005F/1005F Reheat.

RILEY

All of these public utilities have purchased Riley Steam Generating Equipment.

†Dallas Power & Light Co.
†*Texas Electric Service Co.
†*Houston Lighting & Power Co.
*City of Los Angeles, Dept. of Water and Power
†*Louisiana Power & Light Co.
Monongahela Power Company
Potomac Edison Co.
West Penn Power Co.

Arkansas Power & Light Co.
*Utah Power & Light Co.
†*Florida Power Corporation
Florida Power & Light Co.
*Central Illinois Light Co.
†Southern Nevada Power Co.
†*Central Louisiana Electric Co.
Northern States Power Co.
Philadelphia Electric Co.

Commonwealth Edison Co.
Northern Virginia Power Co.
Gulf Power Co.
Pennsylvania Electric Co.
Interstate Power Co.
Ohio Edison Co.
Montana-Dakota Utilities Co.
Mississippi Power Co.
Otter Tail Power Co.

†New Orleans Public Service Co.
†Southwestern Gas & Electric Co.
*Public Service Co. of Indiana, Inc.
Columbus & Southern Ohio Electric Co.
South Carolina Electric & Gas Co.
Southwestern Public Service Co.
Union Electric Co. of Illinois
*Dairyland Power Cooperative
Iowa-Illinois Gas & Electric Co.

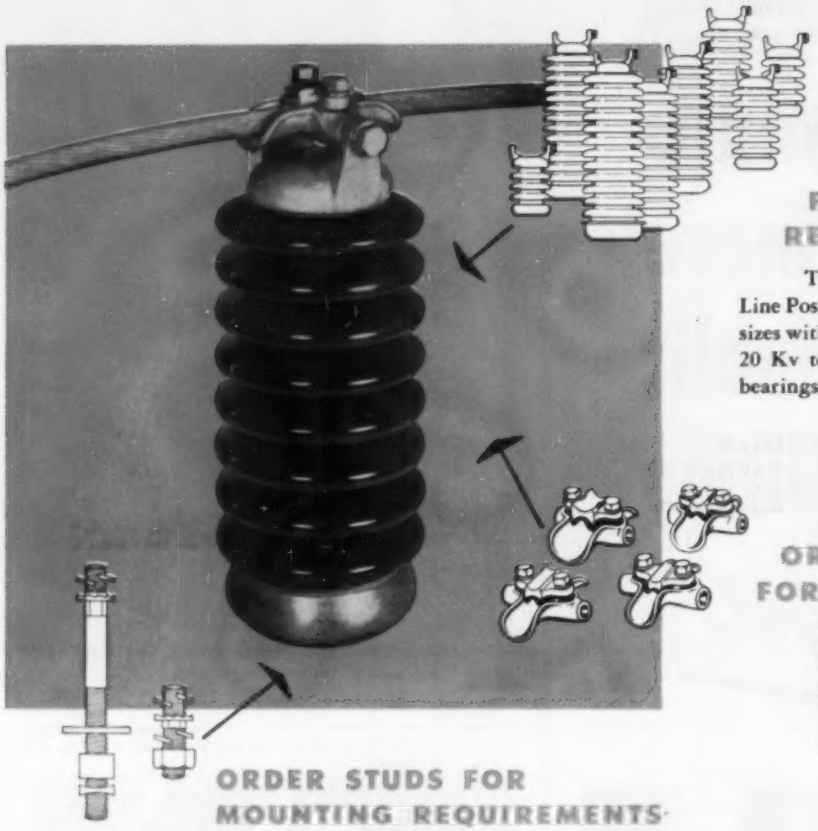
*Reheat †Pressurized

FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER AND HEATING PLANTS

LOW INVENTORY

and ECONOMICAL WAREHOUSING

with LAPP CLAMP-TOP LINE POSTS



ORDER INSULATORS FOR VOLTAGE REQUIREMENTS

The series of Lapp Clamp-Top Line Posts consists of insulators in eight sizes with ratings for line voltages from 20 Kv to 88 Kv. Caps with trunnion bearings are identical in all sizes.

ORDER CLAMPS FOR CABLE SIZES

Four sizes of clamps (choice of ferrous or aluminum) provide for conductors of sizes .25" to 1.50" diameter. Every clamp fits every insulator size.

ORDER STUDS FOR MOUNTING REQUIREMENTS

Studs on Lapp Line Posts are separable. 7" studs for wood cross-arms, 1¾" studs for metal mounting—or longer studs to go through poles for horizontal mounting of insulators—are interchangeable, and may be installed in the field. Serrated surfaces in insulator base and stud flange engage a "positive" lock washer—provide a permanent vibration-proof attachment.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

ONE MORE REASON TO CHOOSE PRITCHARD COOLING TOWERS:

EVERY MEMBER IS WORKING HARDER NOW— YOU SAVE ALL THE WAY DOWN THE LINE!

That's why the new Pritchard cooling tower framework design means savings to you. The new design utilizes materials to the fullest possible extent. As an example, each diagonal member is used in both tension and compression. Result . . . a stronger, more efficient structure.

What does this mean to you? It means that Pritchard towers now offer you the following new advantages:

- Elimination of excess framework members reduces material and freight costs.
- Installation is faster and easier. You save on field labor costs.
- Basin cost is far less. Simplified design requires anchoring only around the periphery of the tower. Inside the basin, it is no longer necessary to build post-supporting piers — post extensions can be provided at far less cost.
- A Pritchard tower is now even easier to maintain . . . there are fewer connections to check.

Pritchard tower framework has always been completely pre-fabricated on precision machines for perfect fit. Now, new Pritchard design adds new efficiency, new economy. One *more* reason to choose Pritchard cooling towers!

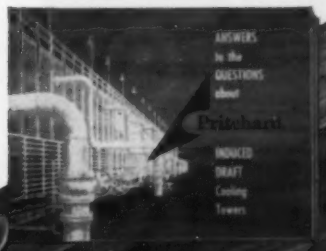
INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
AIR COOLED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

J.F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 420, 4625 Roanoke Parkway, Kansas City 12, Mo.

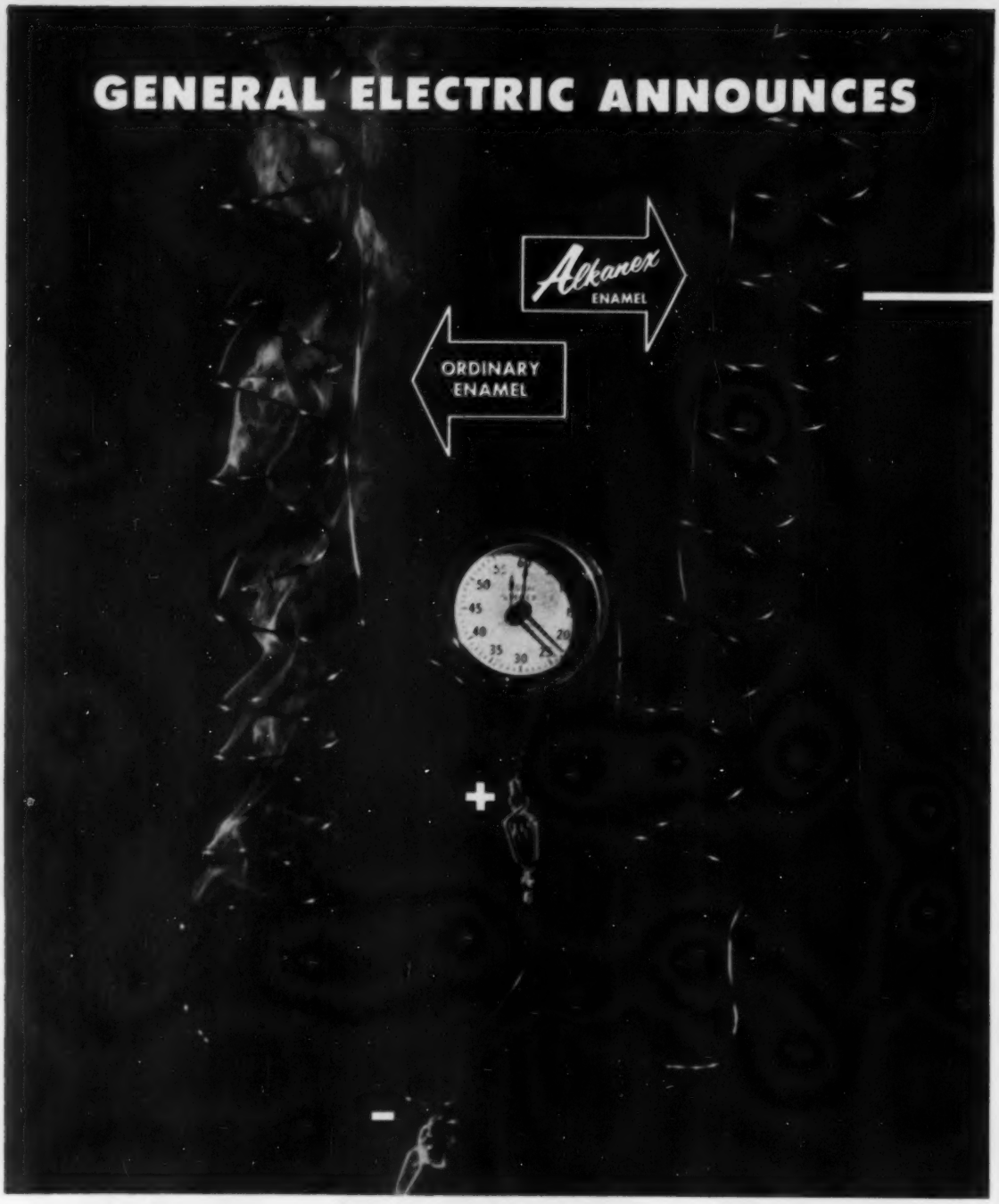
new!



Get your complimentary copy of the new Pritchard brochure, "Answers to the 15 Questions About Pritchard Induced Draft Cooling Towers." Fascinating reading to anyone interested in learning more about cooling towers. Your copy awaits — write for it today on your company letterhead.

The raised ring around the circumference of one end of the Pritchard connector casting matches the ring groove in the framework member. Thus, stress or strain is never on the bolt, but is evenly distributed over the entire area of the ring.

GENERAL ELECTRIC ANNOUNCES



HERE'S A VISUAL DEMONSTRATION OF HEAT RESISTANCE!

In this laboratory test, arranged to demonstrate the heat-resistance of Alkanex enamel compared with conventional enamel, two coils of magnet wire were simultaneously grounded in a dead "short circuit," producing temperatures on the surface of the wire considerably *in excess of 250 C.* In less than 20 seconds the coil on the left, coated with conventional enamel, began to smoke and in approximately 45 seconds the enamel coating had disintegrated. At that point the coil of wire on the right, coated with Alkanex enamel, had barely begun to smoke even though the wire temperature greatly exceeded the normal limits for Alkanex enamel.

Alkanex WIRE ENAMEL

A NEW INSULATING ENAMEL WITH

- **OUTSTANDING HEAT-RESISTANT QUALITIES**
- **EXCELLENT DIELECTRIC AND MECHANICAL PROPERTIES**

General Electric is proud to introduce ALKANEX wire enamel—an insulating enamel whose outstanding properties include the ability to withstand temperatures of 175 C for a limited time and at least 150 C in continuous service.

By using wire coated with Alkanex enamel, equipment can be designed with far greater latitude in temperature limitations. Overload protection can be readily increased; and, thanks to better aging properties, phase and turn insulation can conceivably be eliminated in smaller motors and coils. Higher-temperature equipment, which previously required bulkier insulated magnet wire may now be able to take advantage of space-saving enameled wire.

In short, Alkanex wire enamel facilitates the design of equipment for greater compactness, operation at higher temperatures, and longer life, thus permitting increased ratings for any given frame size—in other words, "MORE POWER PER POUND!"

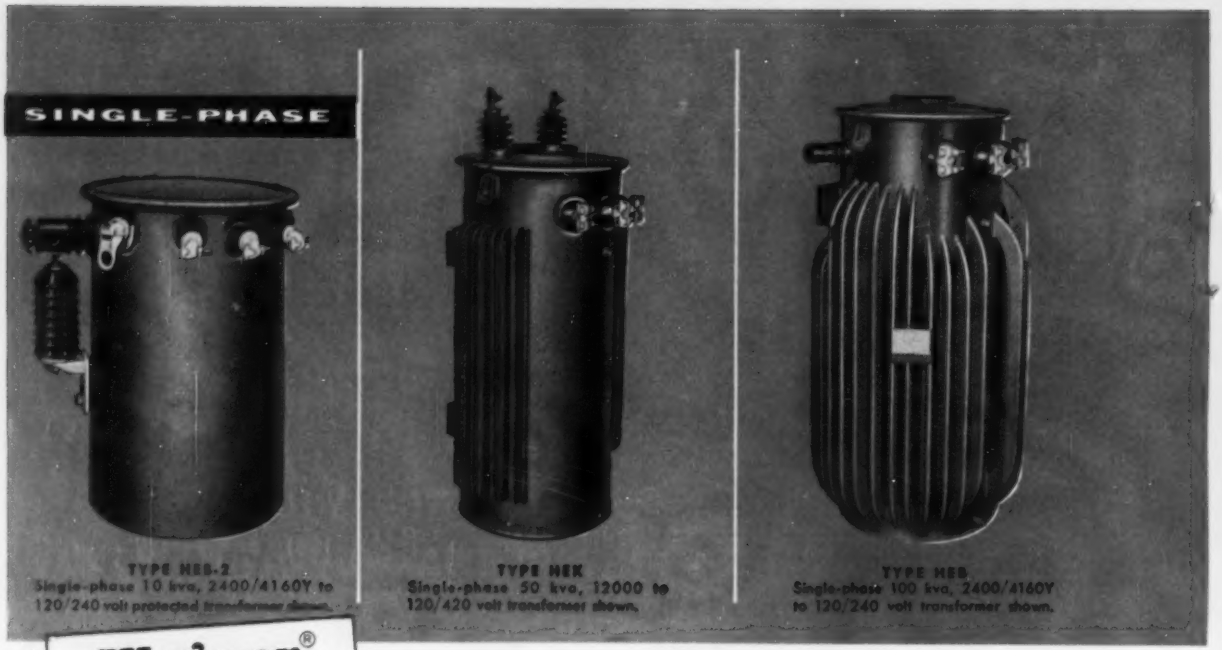
Naturally, we'll be glad to send you salient details on this new wire enamel that combines excellent mechanical and dielectric properties with an *increase of 35-40 C* in operating temperature limits. Just write to *General Electric Co., Chemical Materials Dept., Sect. 513-1B, Bldg. 77, Schenectady 5, N. Y.*

"More Power per Pound"...with GE INSULATING MATERIALS

Insulating varnishes and wire enamels • Silicone resins • Varnished paper and cloth
Mica products • Electrical-grade laminates

Progress Is Our Most Important Product

GENERAL ELECTRIC


SINGLE-PHASE
TYPE HEB-2
Single-phase 10 kva, 2400/4160Y to 120/240 volt protected transformer shown.
TYPE HEK
Single-phase 50 kva, 12000 to 120/420 volt transformer shown.
TYPE HEB
Single-phase 100 kva, 2400/4160Y to 120/240 volt transformer shown.

Wagner®
TRANSFORMERS
... the choice of leaders in industry

When it comes to

WAGNER WILL MEET YOUR REQUIREMENTS!

The Wagner line of Distribution Transformers, that meets *all* EEI-NEMA Standards—will also meet *all your* requirements, no matter how varied they may be. Wagner Distribution Transformers are available in all standard kva ratings and voltages.

If you want a 3 kva, pole-type transformer—Wagner has it. If you want a 150 kva, vertical-type transformer, Wagner has it, too. But these are requirements more in the nature of specifications. We're sure you have *other* requirements for the transformers you buy—such as dependability . . . long service-life . . . maintenance-free performance. Setting high standards for quality materials and careful workmanship are *additional* requirements met by Wagner Distribution Transformers.

Then there are the *extra* features of Wagner Distribution Transformers . . . like the Wagner Shur-Seal Clamping Ring, the high voltage side-wall bushing, the locked low voltage bushing and the Wagner Form W element. *All* Wagner Distribution Transformers are filled with inhibited oil to reduce oxidation and retard the formation of acids and sludge.

You get quick delivery, too. Wagner's expansion program has provided a new plant, devoted exclusively to the manufacture of transformers, to help meet the growing demand for Wagner Transformers. In addition, Wagner has a nation-wide organization to provide fast, convenient service—with branches in 32 principal cities.

Get in touch with your nearby Wagner branch today. Write for your copy of Bulletin TU-180. It gives complete information on Wagner Distribution Transformers.

TYPE HPK
Three-phase 225 kva, 7200 to 240 x 480 volt transformer shown.

TYPE HPB (Vertical)
Three-phase 112.5 kva, 2400 to 208Y 120-volt transformer shown.

TYPE HPB
Three-phase 75 kva, 2400 to 240 x 480 volt transformer shown.

Distribution Transformers...

HIGH VOLTAGE SIDEWALL BUSHING

This high voltage sidewall bushing permits *faster* connections because the conductor is simply pushed into the connector and tightened with a few turns of the knob... *easier* because no tools are needed... are *safer* because the knurled knob is insulated to protect the lineman from accidental shock.

LOCKED LOW VOLTAGE BUSHING

These bushings are keyed to prevent rotation. The porcelain is keyed to the tank and the metal stud is keyed to the porcelain. There can be no loose connections on the inner end of the terminal studs because it is impossible for these studs to turn when the terminals are being tightened.

SHUR-SEAL COVER

Covers of pole-type transformers with round tanks are sealed to the tank with the Wagner Shur-Seal Clamping Ring. "Breathing" is completely prevented and no loss of oil can occur at any time. The Shur-Seal ring maintains equal pressure all around the cover—yet the cover may be easily removed by loosening a single, stainless steel bolt.

Wagner FORM W ELEMENTS

All Wagner single-phase distribution transformers in ratings 500 kva, 15 kv and below, are furnished with Wagner Form W core and coils which permit a liberal design in small size, lightweight transformers and which give excellent electrical performance.

T55-4

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave. • St. Louis 14, Mo., U. S. A.

Wagner Electric Corporation EST. 1891

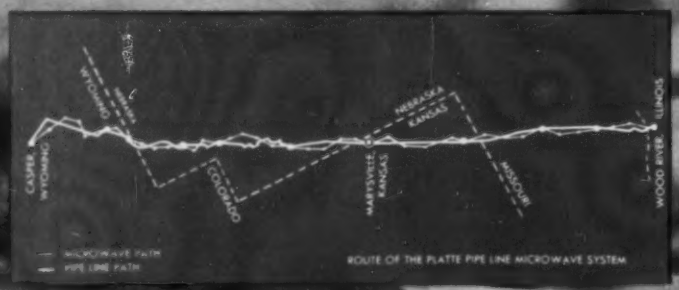
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

PHILCO MICROWAVE...

HOW PHILCO MICROWAVE IS HELPING PLATTE:

- **Operating efficiency increased.**
- **Operating costs reduced.**
- **Provides these communications facilities:**
  4 separate telephone circuits for business, dispatch, confidential and stockholder use.
- **Provides these control functions from Kansas City Control Center:**
  Reading of tank levels, pressure, flow of oil.
  Opening and closing of line valves.
  Start and stop main line pumps.
  Station shutdown.



ROUTE OF THE PLATTE PIPE LINE MICROWAVE SYSTEM

Platte microwave repeater station at Midway, Wyoming

PHILCO Symbol of QUALITY

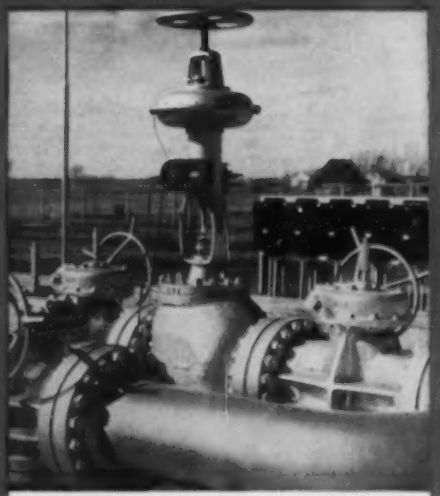
PHILCO CORPORATION

...boosts Platte Pipe Line efficiency!

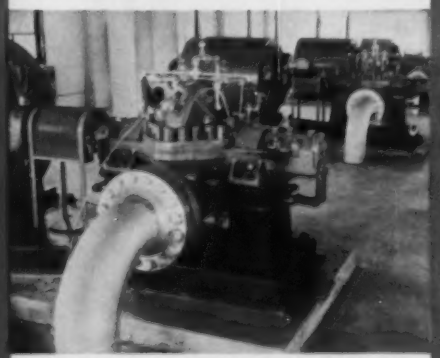
The Philco microwave system of the Platte Pipe Line Company—the largest and most comprehensive installation of its kind—demonstrates the economic advantages of microwave better than any other pipe line microwave system in the nation. Here is what A. R. Heidebrecht, Chief Engineer of Platte, has to say about the system: "Our decision to use microwave was greatly influenced by the number of pipe line control functions which could be accomplished remotely and automatically. Operation to date has proved very successful; in fact, during the short time this system has been in use, the efficiency of our pipe line operation has been substantially increased."

Perhaps microwave can lower operating costs and boost the efficiency of your plant. Philco maintains a staff of experienced field and system engineers who can help plan and install your microwave system. Get information on the many leading Philco microwave installations in use today. Write to Philco, Dept. EW.

Platte Pipe Line control center at Kansas City.



Microwave operates valves along the pipe line.



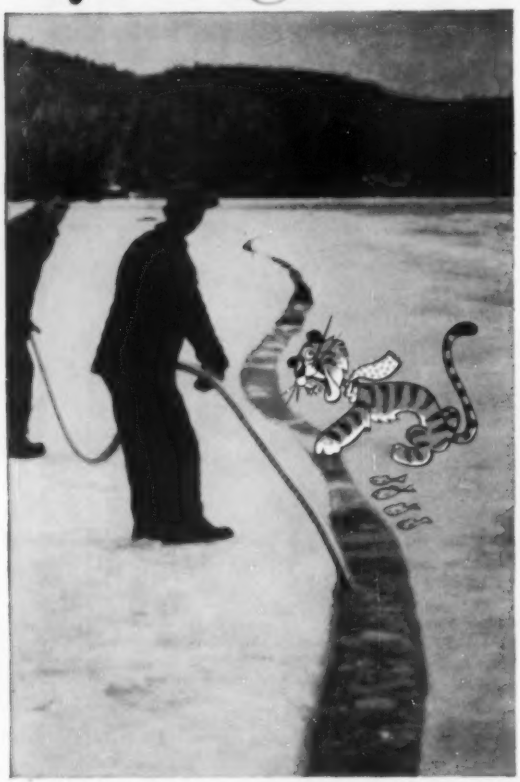
Pipe line pump station operated by microwave.

PHILCO—WORLD'S LEADING MANUFACTURER OF MICROWAVE

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44, PENNSYLVANIA

In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario

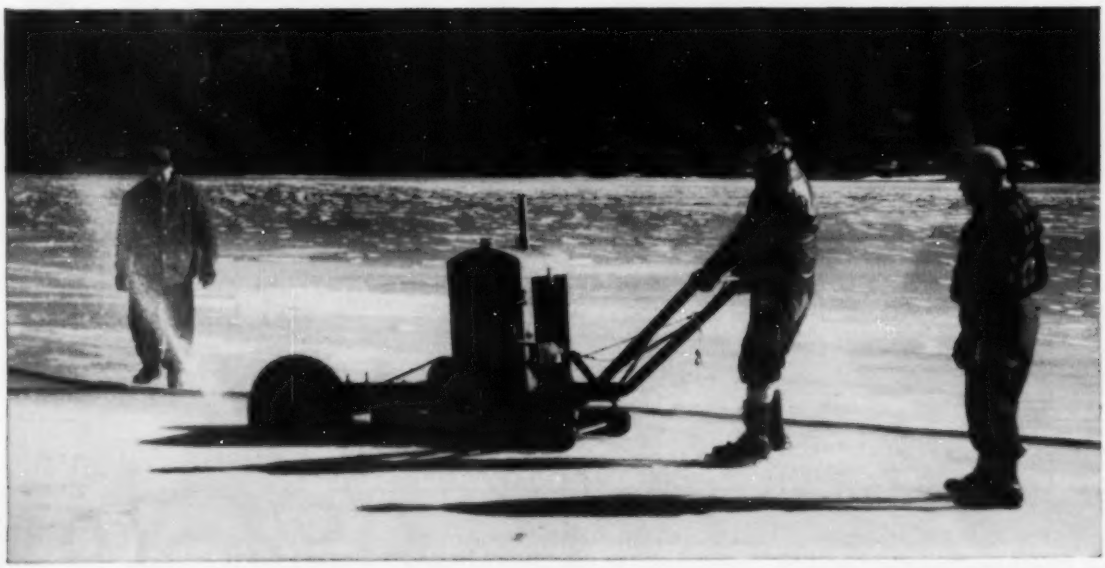
Power company saws through lays *Tiger Brand* Submarine



In she goes. Cable was orginally pulled across the lake with a jeep. The steel armor on cable took up the pulling strain.

Crew of men jockey the cable into position before cutting trench. Mr. Finch says, "We were amazed at the flexibility of the cable."

This is one of the two ice saws used for cutting the trench. It is gasoline powered, mounted on skids.



11 inches of hard ice . . . Cable without boats or barges

• The scene is Upper Saranac Lake, N. Y. Paul Smith's Electric Light & Power and Railroad Company wanted to lay a 2000-foot continuous length of Tiger Brand Submarine Cable under water. Ordinarily this would require expensive boats, barges and crews.

But Raleigh Finch, General Superintendent, decided to wait for a big freeze, saw a slot in the ice, then drop the cable to the bottom. The cable was so flexible, that it only took 15 minutes to unroll the entire 2000 feet onto the ice. The picture captions explain how the job was done.

The cable involved is 2-conductor, 5000V, #4 AWG, steel armored, rubber insulated, non-leaded. It was selected because of its flexibility, light weight and low cost. The cable joins a previous Tiger Brand Submarine Cable that was laid in 1932. According to Mr. Finch, "We haven't had a service failure in that cable since it was laid 24 years ago. In fact, we've never had a piece of Tiger Brand fail, in the 30 years that we've been using it."

Any user of electrical cable can have this same kind of reliable performance. Just switch to Tiger Brand.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB!

- asbestos wire and cable
- mold cured portable cord
- aerial, underground and submarine cable
- shovel & dredge cable
- paper & varnished cambric cable
- machine tool & building wire
- special purpose wire & cable

USS Tiger Brand ELECTRICAL WIRE & CABLE

UNITED STATES STEEL

NEW UTILITY STATIONS C-E EQUIPPED

Includes only new stations on new sites placed in operation since the war (in white) and those under construction or being engineered.

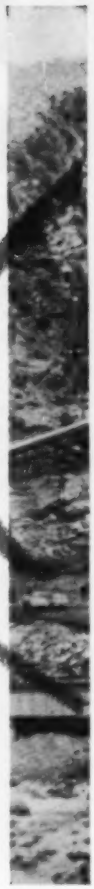
TIDD • JENNISON
CECIL LYNCH • HAVANA
MEREDOSIA • PERMIAN BASIN
O. H. HUTCHINGS • REX BROWN
HICKLING • B. C. COBB
RUSSELL • SEWAREN
POSSUM POINT • CUTLER
PORT JEFFERSON • WHITE RIVER
POTOMAC RIVER • GADSDEN
W. SPRINGFIELD • WOOD RIVER
DAN RIVER • LAKE CATHERINE
HARRY NEWMAN • JIM HILL
HUTCHISON • YATES
DUNKIRK • TITUS • LEE
CONTRA COSTA • HAWTHORN
NINEMILE POINT • EDGE MOOR
PALATKA • JOHNSONVILLE
DANSKAMMER • BECKJORD
HIGHGROVE • PLANT X
BLACK DOG • ALBANY
JOPPA • MERAMEC
PORTSMOUTH • LAKE CREEK
ETIWANDA • AURORA
HENNEPIN • EASTLAKE
OAK CREEK • SUWANNEE RIVER
URQUHART • KINGSTON
SANDOW • MULLERGREN
BARRY • NORTH OMAHA
WILMINGTON

CARBON

SAGUARO
VERMILION
MILLIKEN
GALLATIN
JOHN SEVIER
BARRETT

new CARBON steam plant

now in service



The new Carbon Plant took its place in Utah Power & Light Company's rapidly growing power system last November 5th. This new plant, located at the mouth of a coal mine in Castle Gate, Utah, is the company's fourth new station to be placed in service since the war.

The Carbon Plant, with an initial capacity of 66,000 kilowatts, brings to 251,000 kilowatts the new expansion program. Second-largest in the U.P.&L. system, Carbon will be the most economical, because of the low fuel costs made possible by its convenient location adjacent to fuel supply.

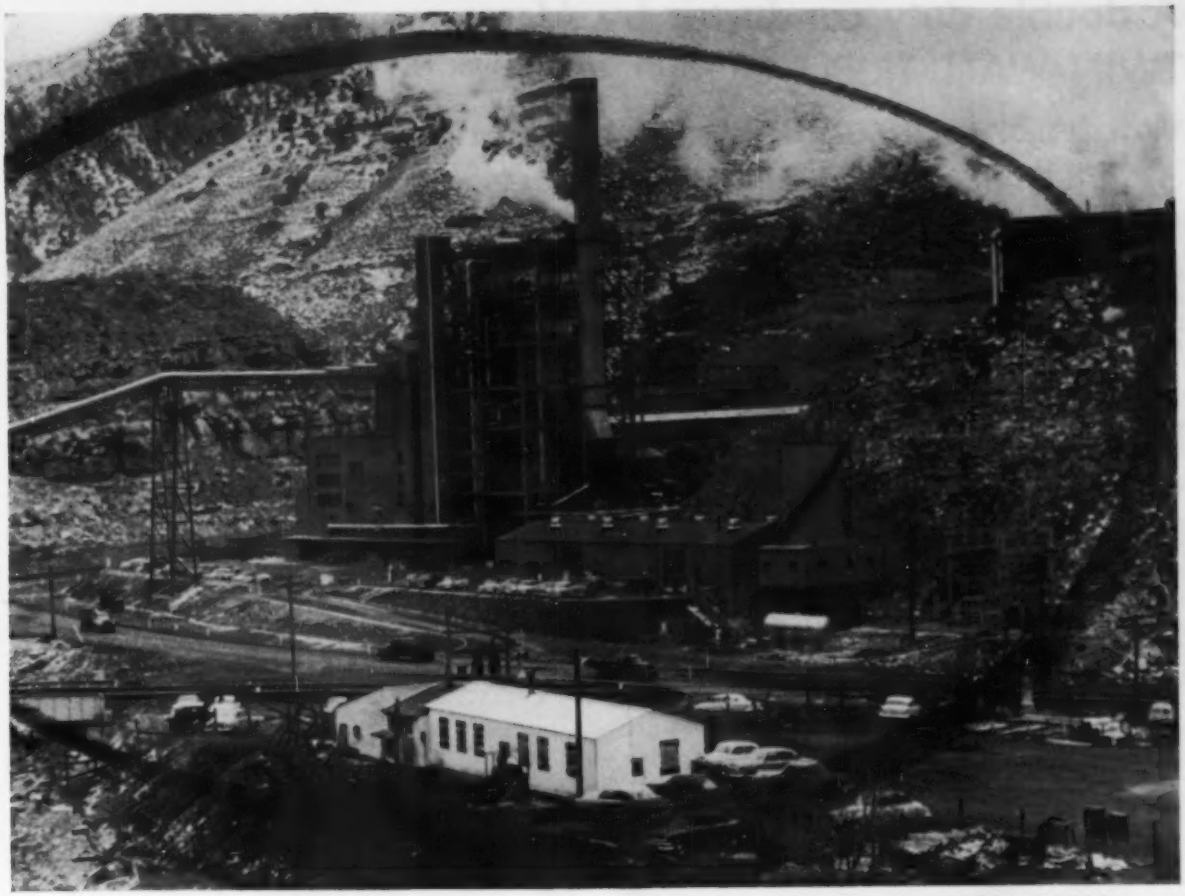
The single 66,000-kw turbine-generator at Carbon is served by a C-E Steam Generating Unit with a maximum continuous capacity of 620,000 lb of steam per hr at 1335 psi and 955 F. A cross-sectional elevation and brief description of the boiler appear on the opposite page.

B-819

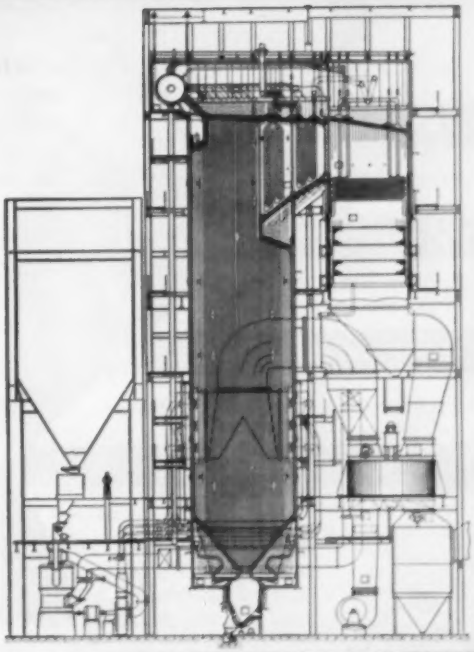
COMBUSTION

Combustion Engineering Building

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASHDRYING



Shown at the right is a cross-sectional view of the C-E Unit now in service at the Carbon Plant. It is a radiant type boiler with 2-stage superheater, and economizer surface in the last pass. Regenerative type air heaters follow the economizer surface. The unit is designed for pulverized coal firing using bowl mills and tilting, tangential burners. This is an "outdoor" type boiler as shown in the illustration above.

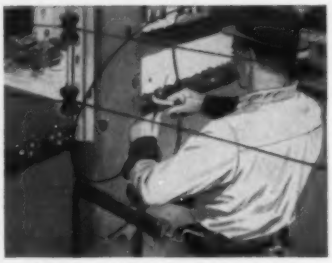


ENGINEERING

200 Madison Avenue, New York 16, N. Y.

SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

A double-duty conductor by Alcoa—
TWIN-WALL TRIPLEX
with rubber insulation and tough neoprene jacket



Want top electrical and mechanical performance in triplex service drop? Then specify Alcoa® Aluminum Twin-Wall Triplex.

This Alcoa Conductor does double duty, thanks to twin thicknesses of rubber and neoprene. The inner sheath of highest quality rubber insulation provides top dielectric performance. The overcoat of wear-and-weather-resistant neoprene assures durability under toughest service conditions. Another proof that Alcoa always offers the best.

For complete information on lightweight, clean, free-stripping Alcoa Aluminum Twin-Wall Triplex—rubber insulated, neoprene jacketed—call your local Alcoa sales office. Or write: Aluminum Company of America, 2312-D Alcoa Building, Mellon Square, Pittsburgh 19, Pa.

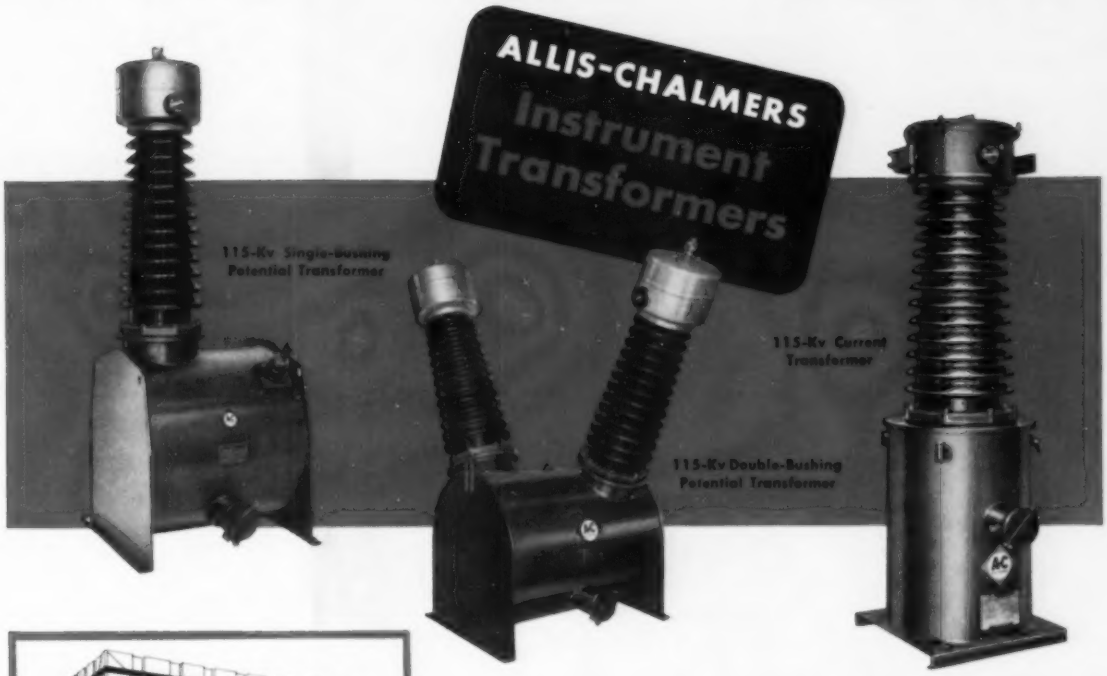
Your guide to aluminum value

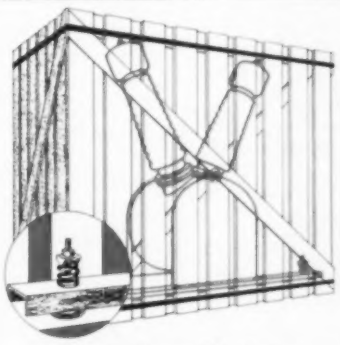
ELECTRICAL CONDUCTOR MADE OF
ALCOA
ALUMINUM
ALUMINUM COMPANY OF AMERICA

#4 SOLID ALUMINUM PHASE CONDUCTORS
#6 ACSR (6 OVER 1 STRANDING) NEUTRAL
2/64" WEAR-AND-WEATHER-RESISTANT NEOPRENE
2/64" HIGHEST QUALITY RUBBER INSULATION

ALWAYS USE ALCOA ALUMINUM ACCESSORIES WITH ALUMINUM CONDUCTORS

New, compact, lightweight design extended to higher voltage classes





Shipped on Springs for Maximum Protection

During shipment, each Allis-Chalmers large current or potential transformer floats on springs in a specially designed crate. Result: maximum protection against damage en route. Assurance that you will get a unit in top condition ready for service.

NOW YOU CAN TAKE ADVANTAGE of Allis-Chalmers new designs for oil-insulated outdoor current and potential transformers for circuits through 115 kv. They take less space, require less foundation or mounting structure than older designs. They are easier to handle during installation.

Corona-Free Design for Long Life

All units in the line are corona-free. They utilize solid insulation at critical points to reduce stresses and lengthen life. Extensive internal overvoltage tests have proved all voltage classes.

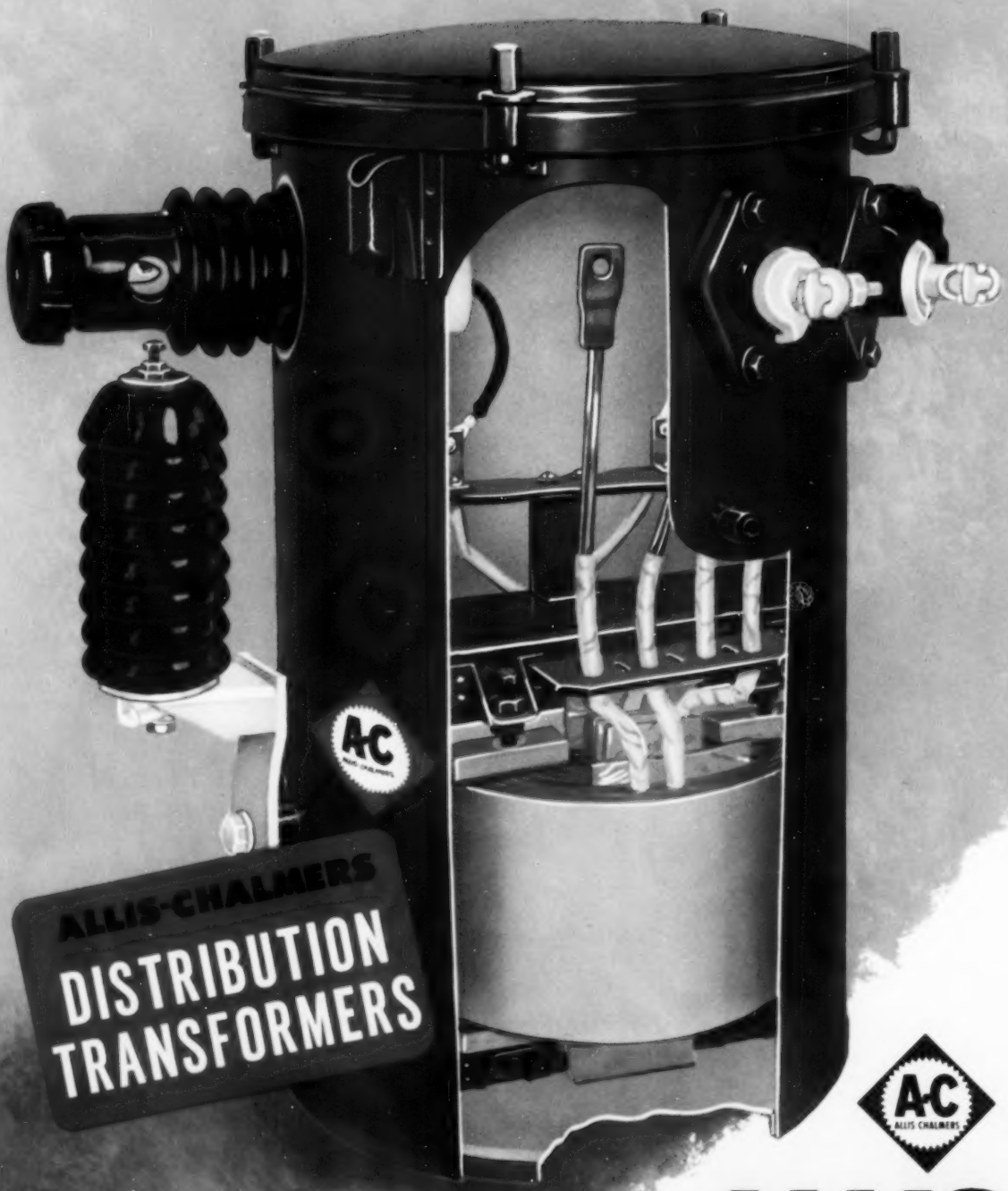
Sturdy Construction

Tanks are all-welded, hermetically sealed to protect insulation and oil from sludge formation. Unique bushing construction provides for an oil reservoir common to both bushing and transformer, reducing the oil requirements and cutting the size and weight.

Get more information by calling your nearby A-C district office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for your copy of "PT's Are Getting Smaller." A-4544

ALLIS-CHALMERS

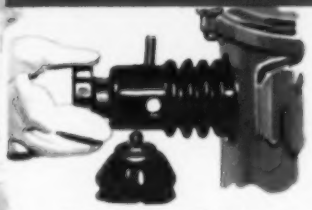
Which Distribution



ALLIS-

Transformer Is Best?

Check these
6 FEATURES
...then decide for yourself



NEW HIGH VOLTAGE SIDEWALL BUSHING

Simplifies installation; assures reliability. No more splicing because connector grips two standard conductors as large as No. 2 stranded cable at same time. Safety-designed hand-knob can't be unintentionally removed, positively protects against touching "hot" parts. Use either copper or aluminum conductor. Serrated ram prevents conductor twisting or slipping. Follow-up spring maintains positive contact pressure. No metal-to-porcelain contact at any point. Retained Corprene gaskets. Simplified bushing cable connection to terminal board makes maintenance easy.

NEW LOW VOLTAGE BUSHING

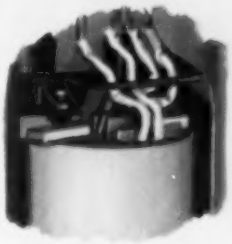
Double key design gives positive protection against rotation, eliminating a major possibility of internal short circuit and maintaining effectiveness of seal. Connector stud is keyed to bushing porcelain. Bushing is keyed to tank wall. Connector and stud are one piece. Corprene gaskets are fully retained, are compressed without twist or shear. Tinned clamp-type connectors permit use of either copper or aluminum.

NEW TANK AND COVER DESIGN

Machine welding throughout. Tapped lugs welded to tank surface so that internal thread is not exposed to damage. Tank bottom is recessed with straight wall inside and out — no place for condensation or water to collect. Cover and tank have horizontal gasket surface to assure proper compression of gasket with no possibility of shear. Gasket is fully retained. Cover clamps are captive, will not drop to ground when loosened. All tanks are pressure-tested at 50 psi.

NEW COIL SUPPORTS

Coils are locked firmly in position with adjustable-type coil supports. Pad under support distributes pressure evenly. Pads are specially compounded alkyd polyester impregnated glass fiber for strength.

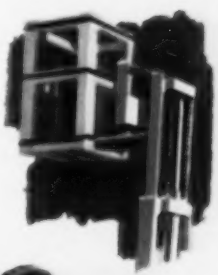


NEW HOT SPRAY PAINT PROCESS

Allis-Chalmers exclusive hot spray paint process assures maximum protection under all conditions because it puts paint, not solvent, on transformers. As a result, you get an even flow of high content, specially developed alkyd resin enamel that provides a smooth surface with high gloss and thorough coverage.

NEW SHIPPING CRATE IS RE-USABLE PALLET

Now Allis-Chalmers distribution transformers are shipped in a pallet-base crate that simplifies storage and provides a convenient pallet usable on other materials after transformer is uncrated.



SEE FOR YOURSELF

All these features and more are conveniently, graphically explained and demonstrated in the "Allis-Chalmers Visualizer." Call your nearby A-C district office and ask to see it. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for more information.

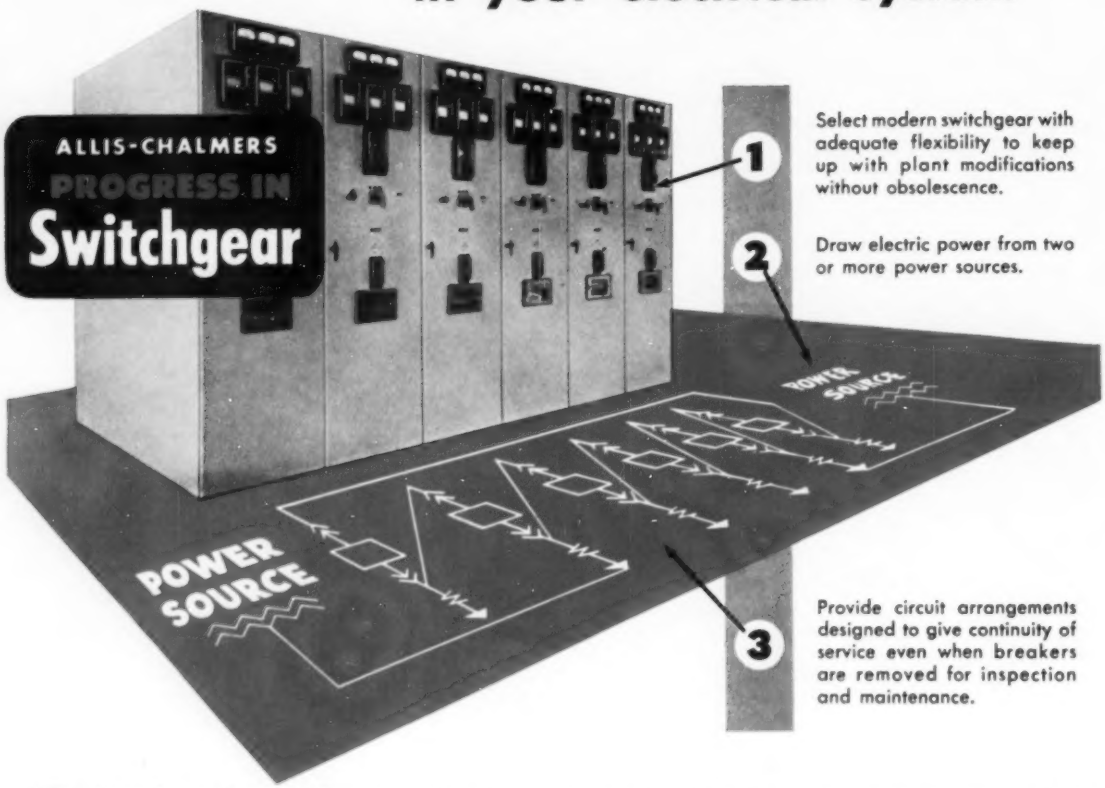
A-4531

CHALMERS

For uninterrupted power . . .

combine these 3 features

in your electrical system



Select modern switchgear with adequate flexibility to keep up with plant modifications without obsolescence.

Draw electric power from two or more power sources.

Provide circuit arrangements designed to give continuity of service even when breakers are removed for inspection and maintenance.

The 3 points above offer a simple rule of thumb for planning an electrical system that will provide uninterrupted power.

Key to the operation of such an electrical distribution setup is the switchgear. Allis-Chalmers has specialized in this type of switchgear engineering and offers these advantages to the user:

SAVES SPACE — Allis-Chalmers switchgear compartments are designed with room to permit adding special transfer bus or ring bus arrangements without adding auxiliary cubicles.

SAVES COST — No matter whether you eliminate duplicate facilities or simply eliminate extra cubicles, there is a substantial cost saving with Allis-Chalmers switchgear.

SAVES TIME — Allis-Chalmers dry-type bus joint insulation makes it easy to add or remove switchgear cubicles. No insulating compounds to melt . . . no fuss . . . no muss.

GET COMPLETE INFORMATION on Allis-Chalmers switchgear designed to meet needs for continuous power. Call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4422

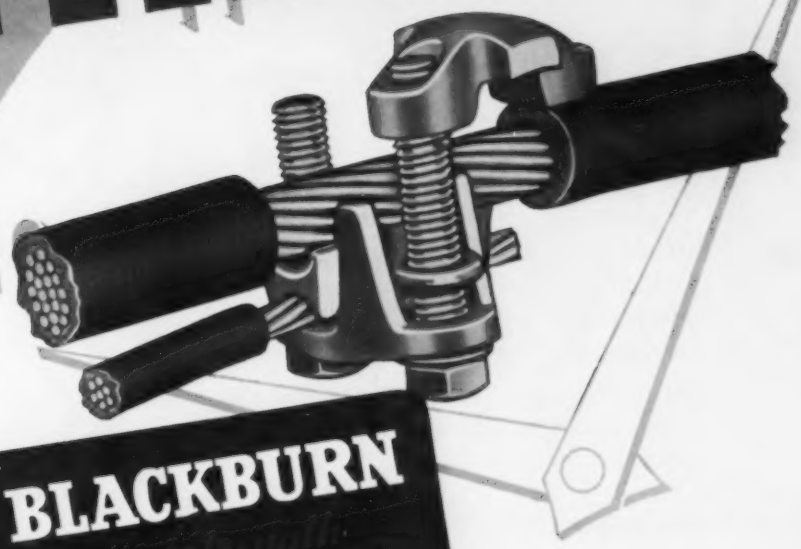
Ask for these booklets:

- ☐ Primary Switchgear Arrangement for Chemical Plants.
- ☐ Continuity of Service at Distribution Voltages by Means of Ring Bus.
- ☐ Design Considerations of Switchgear for Pipeline Substations.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

CUT DOWN INSTALLATION TIME² with



BLACKBURN TWO-BOLT CLAMPS

One piece construction simplifies installation—eliminates assembly problems—no falling parts—no missing pieces—no special tools necessary. Available in copper or heavily tin plated—with or without contoured spacer.

Long bolt is peened, capturing spacer and top casting. Spacer is ringed and swings easily over conductor. Free bolt is held in place by neoprene washer during installation.

Contoured spacer keeps conductor in original shape and distributes unit pressure over large area of conductor, minimizing cold flow and provides wide separation between the aluminum and copper conductor, reducing possibility of galvanic corrosion.

Shakeproof washers prevent loosening under the most severe operating conditions. Washers, castings, bolts and spacers are of copper alloy, completely tin plated.

Write today for complete specifications and prices on Blackburn Two-Bolt Clamps.

JASPER BLACKBURN CORPORATION

35 MADISON • ST. LOUIS, MO. • PHONE: MAIN 1-2821

Once in a Blue Moon
you'll need a
new Power Plant
. . . then Pioneer Service & Engineering Co. with 53 years of experience in this specialized field, stands ready to help you with a complete service including preliminary plans, load studies and site selection, the design of the plant and arrangements for financing its cost.
Our services and facilities are outlined in our booklet, "Pioneering New Horizons" yours for the asking.
53 YEARS
Pioneer Service & Engineering Co.
231 SOUTH LA SALLE STREET • CHICAGO 4, ILLINOIS
Consulting Engineering • Power Plant Design
Purchasing and Expediting • Financial Advisory Service
Forecast, Load Study and Performance Analysis
Stock Transfer and Dividend Disbursement
Valuation, Insurance, Rate and Business Advisory Service

L-M's new Luminaire Supports will hold a 250-pound man!

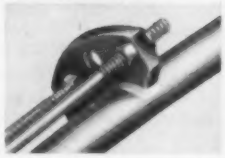
Here's the first complete line of brackets designed specifically to meet customers' requirements for strength, *minimum pole space* (less than the rise of the bracket), and handsome appearance.

Obviously we didn't design them for a gymnasium—but they *are* strong enough so that even the extra-long 20-footers will support a 250-pound man, if he should accidentally put his weight on the end of the arm. Pole plates and tension support members are all welded to the unit to insure ample strength throughout the entire assembly. These designs have all been wind-tunnel-tested for winds up to 150 MPH to assure generous lateral strength.

Pole space required is only one inch per foot of bracket length—except on A-frame brackets, which require not over 1.6 inches per foot. In other words, a 10-foot bracket requires only 10 inches of pole space. The 20-foot A-frame bracket shown above requires only 30 inches of pole space. Installation instructions are marked directly on the support arm.

Units are easy to handle, install, and wire. The entire line is related in appearance so that you can use several types in the same installation, if desired. All types are available in galvanized steel or aluminum; choice of plain, threaded, or street-ell end styles.

Four harmonizing styles of supports, available in various lengths up to 20 feet, in steel or aluminum. Get details on sizes available in each style.



Upper photo: Strong pole fitting has ample strength; held by ⅝-inch thru-bolt and 2½-inch lag screws. Lower: welded support for braces adds strength, minimizes vibration.

Get Complete Information on L-M Street Lighting Application Service

These are the only brackets that have all three advantages—extra strength, minimum pole space, and handsome design. L-M also offers a full line of street lighting luminaires—incandescent, mercury vapor, and fluorescent—and complete street lighting application engineering service. Ask the L-M Field Engineer for information and bulletins. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

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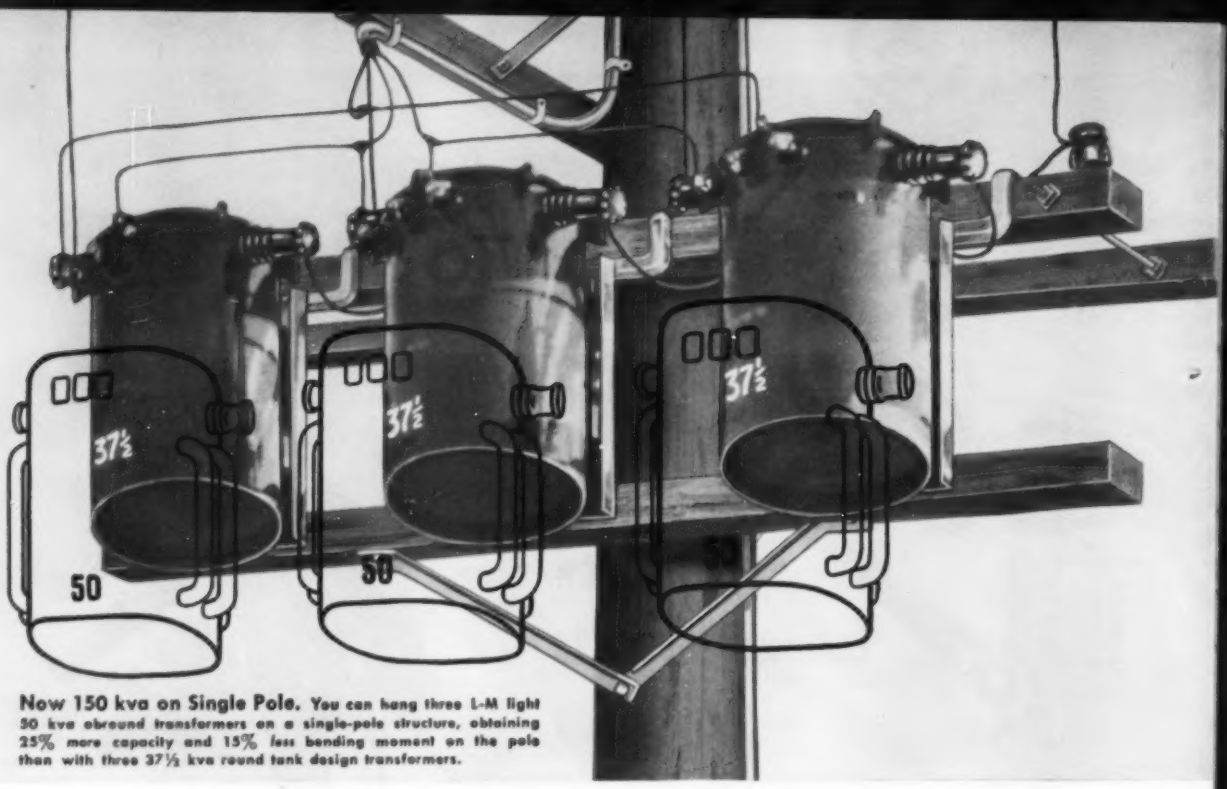
LINE MATERIAL
Street Lighting



Now 150 kva on Single Pole. You can hang three L-M light 50 kva obround transformers on a single-pole structure, obtaining 25% more capacity and 15% less bending moment on the pole than with three 37½ kva round tank design transformers.

How L-M Obround Design Provides Additional Capacity On Structures

New obround tank design is smaller, lighter, has shorter moment arm, retaining all outstanding Round-Wound® performance characteristics.

By ALVIN B. COYLE
Manager
Transformer Sales
Line Material Company

Now you can hang transformers of larger capacity on a pole structure with L-M's lighter, smaller obround transformer tank design. The additional capacity is obtained without changing outstanding performance characteristics of L-M's Round-Wound design.

Less Weight

The obround design provides a smaller tank with less transformer oil, resulting in a lighter, easier-to-handle transformer. Cooling tubes are installed where necessary to provide the cooling surface for maintaining the same low hot-spot and top oil temperature-performance characteristics found in all other L-M transformers. In addition, the transformer's repetitive overload capacity is improved as the result of the faster transfer of heat from the coils to the cooling air.

Shorter Moment Arm

L-M's new obround design brings the center of gravity closer to the pole, which reduces the moment arm distance from the pole. The combination of lighter weight and less moment arm distance substantially decreases the total bending moment on the pole and crossarms, and thus greatly increases the potential capacity of all your transformer structures.

You can take advantage of savings such as these:

Larger transformers can be hung closer to the top of the pole, eliminating the need for a higher pole and additional spacing.

Single-pole, three-phase transformer structures can now serve more load with the additional transformer capacity available. New 50 kva obround transformers have less bending moment on the pole and on crossarms than previous 37½ kva round tank design. Here L-M's light obround transformers may eliminate the need for costly two-pole structures.

Pole-Mounted 167 kva Transformers

L-M's light-weight 167 kva transformer can be pole-mounted; provides a full 167 kva of capacity on a single-pole structure. And it, too, provides L-M's well-known overload capacity.

To serve three-phase loads you can hang three L-M light 167 kva transformers or 500 kva on a two-pole structure, eliminate expensive platforms, ground pads, or vaults in many instances, and make further use of existing facilities.

L-M's light, obround design transformers are available in single-phase 5 kva through 167 kva in each standard distribution voltage class.

Get Details On Lighter-Weight Obround Transformers

Ask the L-M Field Engineer for application information, weights and dimensions on L-M obround transformers and the exclusive Round-Wound design. Or write Mr. Coyle at Line Material Company, Transformer Division, Zanesville, Ohio (a McGraw Electric Company Division).

LINE MATERIAL Transformers

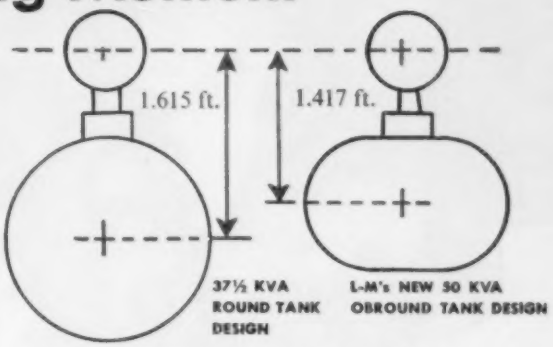
You Can Hang 25% More Capacity With 15% Less Bending Moment

COMPARE 37½ kva round tank design
50 kva L-M obround tank design

37½ kva ROUND tank design:
Moment arm from center of pole. 1.615 ft.
Weight. . . . . 800 lbs.
Bending moment 800 x 1.615. . . . **1292 ft.-lbs.**

50 kva L-M OBROUND tank design:
Moment arm from center of pole. 1.417 ft.
Weight. . . . . 775 lbs.
Bending moment 775 x 1.417. . . . **1098 ft.-lbs.**

L-M's new 50 kva obround transformer has 15% less bending moment than the 37½ kva round tank design.



Less Bending Moment—New obround tank design reduces the moment arm distance from the pole. The combination of lighter weight and smaller moment arm distance greatly decreases the total bending moment on the pole. When crossarm mounted, the lighter weight substantially reduces the bending moment on the crossarms.

Less Weight, Faster Cooling—The obround design affords a small tank and less transformer oil, resulting in a lighter, easier-to-handle transformer. Cooling tubes are installed where required to provide sufficient cooling surface.

In addition, oil ducts, located throughout the coil and between the coil and cruciform cross-section of the wound core, contribute to uniform efficient cooling.

Rapid transfer of heat provides faster cooling of the unit, increasing its repetitive overload capacity.

Plus Outstanding Round-Wound Performance Characteristics

Both the physical and performance characteristics of L-M's obround tank transformer were considered in detail. The advantages of lighter weight and shorter moment arm were accomplished with no sacrifice of outstanding Round-Wound performance characteristics.

Low Exciting Current: the continuously wound core of oriented-grain silicon steel strip provides a uniform flux path, thus permitting low exciting current.

High Impulse Strength: high-voltage windings are on the outside of the coils, providing maximum distance between the high-voltage windings and the core. This permits ample creepage distance with generous insulation.

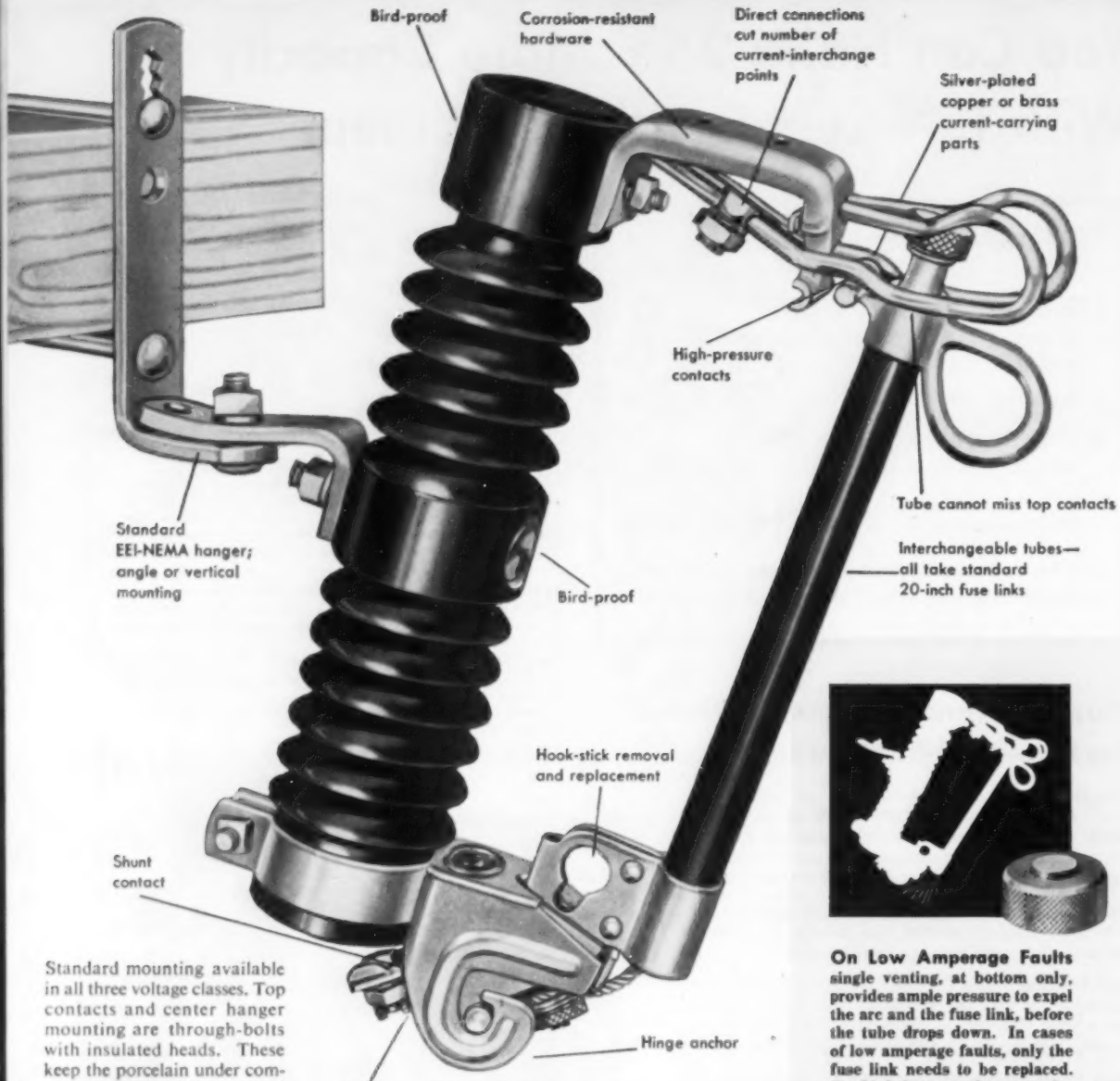
High Short-Circuit Strength: round coils naturally resist radial short-circuit forces without damage or distortion. Sturdy core clamps and strong blocking aid in preventing axial movement of the windings under short-circuit conditions.

High Short-Time Overload Capacity: cruciform cross section of wound core and ducts between windings and layers provide excellent cooling for the entire unit.

Now you can hang 167 kva directly on the pole, yet L-M's new lightweight obround has full 167 kva continuous rating and no sacrifice in overload capacity.

LINE MATERIAL

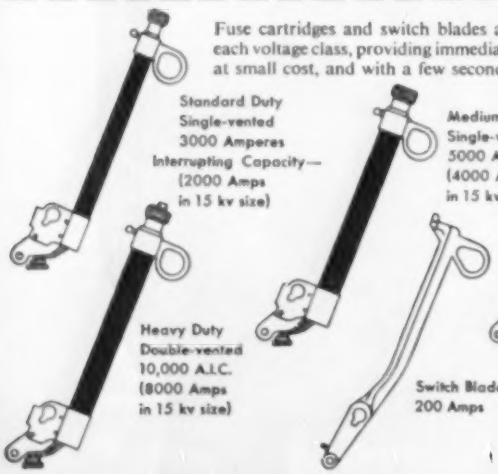
LM Transformers


Bird-proof
Corrosion-resistant hardware
Direct connections cut number of current-interchange points
Silver-plated copper or brass current-carrying parts
High-pressure contacts
Tube cannot miss top contacts
Interchangeable tubes—all take standard 20-inch fuse links
Standard EEI-NEMA hanger; angle or vertical mounting
Bird-proof
Hook-stick removal and replacement
Shunt contact
Hinge anchor
Direct connections cut number of current-interchange points

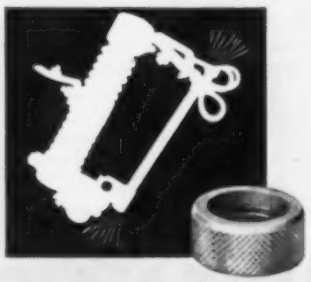
Standard mounting available in all three voltage classes. Top contacts and center hanger mounting are through-bolts with insulated heads. These keep the porcelain under compression, providing added strength and a completely bird-proof design.

On Low Amperage Faults single venting, at bottom only, provides ample pressure to expel the arc and the fuse link, before the tube drops down. In cases of low amperage faults, only the fuse link needs to be replaced. On high interrupting capacity cutouts, the expendable cap, above, right, remains intact, the same as the solid cap.

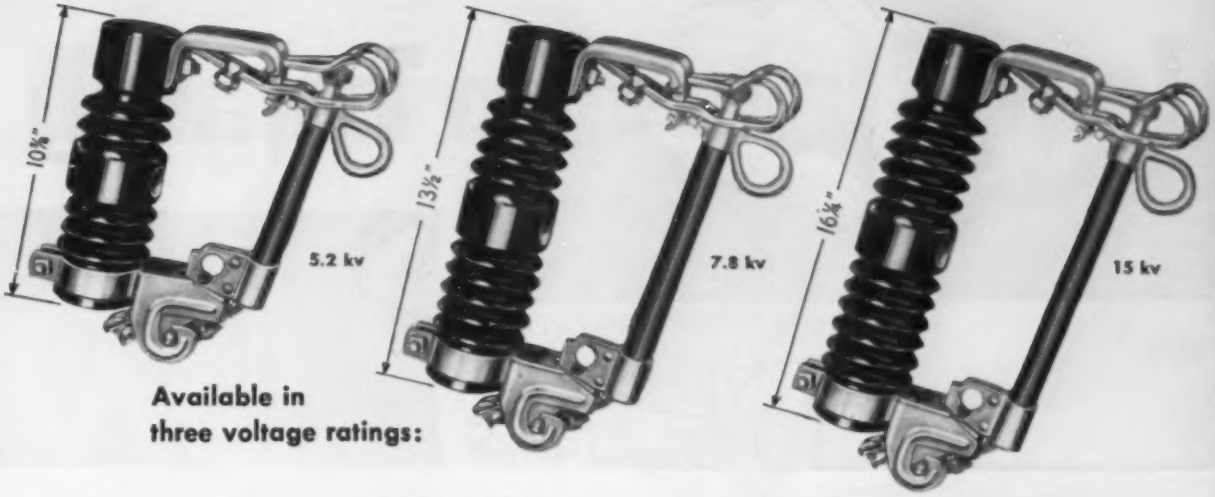
Fuse cartridges and switch blades are completely interchangeable in each voltage class, providing immediate increase in interrupting capacity at small cost, and with a few seconds work with a hook-stick.


Standard Duty Single-vented 3000 Amperes Interrupting Capacity— (2000 Amps in 15 kv size)
Medium Duty Single-vented 5000 A.I.C. (4000 Amps in 15 kv size)
Medium Duty Double-vented 6000 A.I.C. (4000 Amps in 15 kv size)
Heavy Duty Double-vented 10,000 A.I.C. (8000 Amps in 15 kv size)
Switch Blade 200 Amps

Interchangeable load-break cartridges are available for each voltage class cutout. Easy pulling action breaks link inside tube, and arc is cleared before tube can drop.



On High Amperage Faults pressure automatically opens the expendable cap at the top to provide double venting. No bursting of tubes. Gas flashover is eliminated because no cutout parts are in the path of gas discharge.



Available in three voltage ratings:

L-M's New "HDO" Open-Type Cutouts... The Cutout Development Of The Year!

New "HDO" 100-ampere cutouts are the simplest, most rugged, easiest to operate in the industry today. Provide high interrupting capacity, bird-proof design; heavy construction, assuring economy.

By **R. W. KELLY**
Application Engineer
Protective and Switching Equipment Division
Line Material Company

Here's a big new development in open-type cutouts that offers you a tremendous improvement in performance, operation, and economical long life.

The "HDO" is a big, rugged cutout. It is strong, durable. It's the easiest cutout to operate you ever saw. Complete hook-stick removal and replacement of cartridges. Bird-proof construction. Silvered current-carrying parts with few current-interchange points assure ample capacity without overheating. And it operates equally well on high and low fault currents.

Positive Pressure Control

A feature of the "HDO" is L-M's exclusive pressure-controlled expendable cap. On low faults the pressure is confined, assuring consistent, reliable arc interruption. On high faults the diaphragm in the cap opens, relieving the pressure by providing double venting.

Complete Line of Cutouts

Prices for the "HDO" cutouts are extremely reasonable, and the interchangeability feature offers desirable future economies. The complete line includes cutouts in the 5.2, 7.8, and 15 kv classes, with a full line of cartridges in standard- and heavy-duty interrupting ratings, and a 200-ampere switch blade. All cartridges take standard 20-inch distribution fuse links.

Protection That Is Reliable

The many desirable features incorporated in L-M's "HDO" open-type cutout assure positive action, dependable service.

Completely bird-proof construction.

Current-carrying parts all silver-plated brass or copper; this prevents false outages caused by contact heating even after many years of operation.

Cartridge firmly anchored for closing-in on faults; tube cannot move upward; cannot pop out of bottom hinges in closing.

All cartridges are designed for complete removal and replacement with a standard hook-stick.

Maximum interrupting capacities with any size link. Cutout interrupts any fault current from minimum melting of link to maximum cutout rating.

Connectors mounted directly on stationary contacts eliminate several current-interchange points.

Tube cannot miss top contacts, which are heavy silver-plated springs and designed to serve as a guide.

Corrosion-resistant, high-strength hardware has four to six times the life of mild steel.

Get Complete Information

Ask the LM Field Engineer for complete information about L-M's complete line of open and enclosed fuse cutouts and other protective equipment. Or write Line Material Co., Milwaukee 1, Wis. (a McGraw Electric Company Division).

SIZES AND RATINGS

Cartridges	Interrupting Capacity, Amperes 5.2 kv.	7.8 kv	15 kv
Standard Duty Single Venting (Solid Cap)	3000 A.	3000 A.	2000 A.
Medium Duty Single Venting (Solid Cap)	5000	5000	4000
Medium Duty Double Venting (Expendable Cap)	6000	6000	4000
Heavy Duty Double Venting (Expendable Cap)	10,000	10,000	8000
Switch Blade	200 amperes continuous		

All cartridges and switch blades interchangeable in each voltage class.

LINE MATERIAL
fuse cutouts and fuse links

204-R

Taming

COATING RESISTANCE is carefully measured with equipment shown above. Adjustments are made on coating machine with data from this test.

ALLIS-CHALMERS POWER Transformers

EPSTEIN TEST IS MADE ON steel to recheck supplier report on watt loss per pound. Epstein strips are stress-relief annealed before undergoing tests. Multiple samples are taken from coils of steel, then tested in equipment shown above.

VISUAL AND MICROMETER CHECKS throughout all operations provide additional tests for size, lamination, and surface quality. At another point (not shown), core steel is annealed in special equipment in which atmosphere is controlled with respect to dew point to produce desired surface conditions.

ALLIS-

Temperamental Steel

Suppliers Check and Allis-Chalmers Double Checks to Assure High Quality Core Steel . . . Top Performance for Transformers

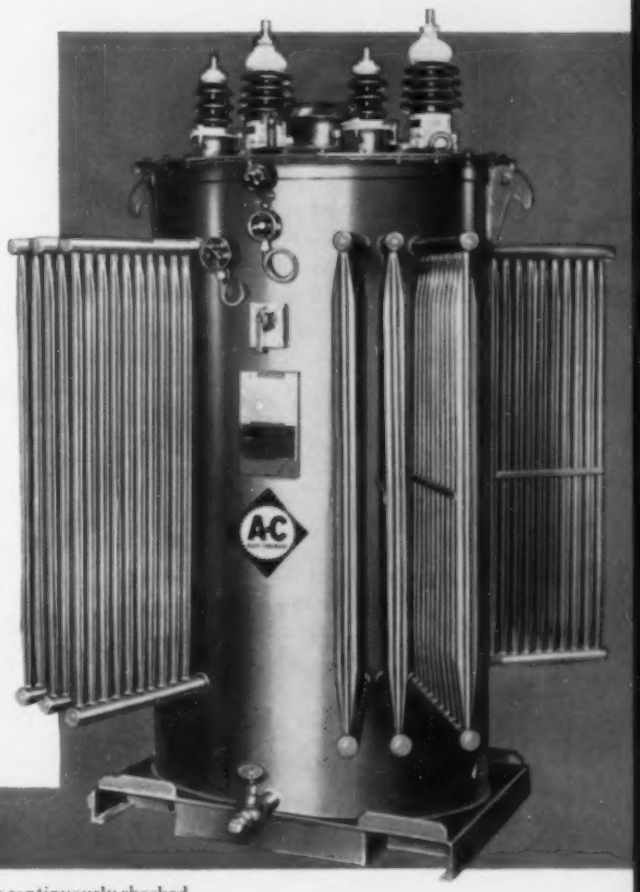
Suppliers apply tests to prove that core steel meets rigid specifications. But that's not enough for Allis-Chalmers. Here's what A-C engineers do to assure highest quality incoming raw materials.

First step extends right back into supplier plants. Allis-Chalmers engineers personally inspect supplier equipment and processes at regular intervals.

As soon as steel reaches an Allis-Chalmers transformer plant, re-checks of quality begin. They do not end until the completed transformer successfully passes all tests on the final assembly floor.

Proof of the effectiveness of these tests comes from the satisfaction of the hundreds of users of Allis-Chalmers transformers. If you would like further information on any of these rigid Allis-Chalmers tests for quality, your nearby A-C district office will get you more information. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, to arrange for a visit to Pittsburgh or Milwaukee so you can see for yourself why Allis-Chalmers offers the highest quality.

A-4706



STEEL SAMPLES are continuously checked to eliminate edge burrs that might result from cutting and slitting operations. Thus burrs cannot cut insulation coating on adjacent laminations which could permit eddy currents to build up, with resulting hot spots in core. Interlamination resistance tests after assembly provide further check.

CHALMERS

A-C ALLIS-CHALMERS

. . . another advance in mercury lighting from G. E.

Now 54% more light from G-E 400-watt mercury lamp

New General Electric H400-RC1 gives top color balance, too

In another mercury lighting first, General Electric has raised the light output of the H400-RC1 mercury lamp from 12,300 to 19,000 lumens! This 54% increase in efficiency results from using a special fluorescent phosphor as a reflector as well as to improve color balance. Its color characteristics are best of any mercury lamp for general lighting. Color rendition approximates a mixture of ⅓ filament light and ⅔ mercury light.

The new G-E H400-RC1 mercury lamp has a life rating of 6000 hours at 5 or more hours per start. It operates on the same equipment as all other 400-watt mercury lamps and is interchangeable in most reflectors.

With its controlled beam, good color, easy maintenance, and high light output, it is first choice for most mercury lighting applications.

For more information on how this new mercury lamp can fit your operation, call your G-E Lamp supplier, or write General Electric Company, Lamp Division, Dept. 166- EW-4, Nela Park, Cleveland 12, Ohio.

COMPARE NEW G-E RC1 WITH OTHER 400-WATT MERCURY TYPES

NEW RC1 VS H400-E1

- Light on the work equal or greater in most equipment
- Adds color balance
- Less maintenance

NEW RC1 VS H400-J1

- Delivers 10-20% more light on the work in most equipment
- Has somewhat better color balance
- Lower cost of light

NEW RC1 VS H400-A1

- 35% more light on the work in most equipment
- Has good color balance
- Lower cost of light

Progress Is Our Most Important Product

GENERAL ELECTRIC

OVERWHELMING FIRST CHOICE FOR 50 YEARS

Compare SQUARE D SAFETY SWITCHES...
line for line and feature for feature

THEY COST NO MORE...WHY SETTLE FOR LESS?

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

Spiral-Bevel Cooling TOWER DRIVE

simple,
compact
sturdy
efficient

Here are features which make these single reduction Spiral-Bevel Units outstanding:

- High Efficiency . . . 97, 98% with small heat loss.
- Precision generated Spiral-Bevel Gears, case hardened for long service life.
- Heavy duty housing construction.
- High dome permits mounting fan directly on unit, with ample clearance below fan blades.
- Spiral-bevel pinion is supported by additional outboard bearing, thus preventing any possible pinion deflection.
- Oversize bearings give extra long life.
- Top bearing is continually flooded with oil—no grease fittings are necessary.
- Economical to operate.
- Reducer meets all AGMA standards.

These widely used Cooling Tower Drives are made in 5 sizes, rated from 15 h.p. to 75 h.p. at 1750 r.p.m. motor speed, with Ratios ranging from 3½ to 9½:1.

Be sure your next Cooling Tower is equipped with this dependable Philadelphia Drive. Literature upon request.

Write for Catalog CT-53, which illustrates and fully describes all types of Philadelphia Cooling Tower Drives and their applications: Spiral Bevel, Helical-Spiral Bevel and Worm Gear.

PHILADELPHIA GEAR WORKS, INC.

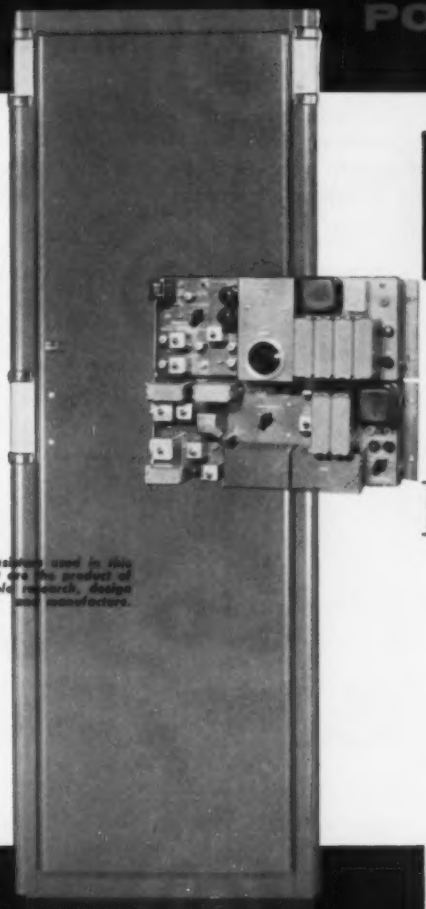
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
Virginia Gear & Machine Corp., Lynchburg, Va.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

ESTABLISHED 1892

FIRST* transistorized
POWER LINE CARRIER



All transistors used in this equipment are the product of Motorola research, design and manufacture.

- Unexcelled continuity of service
- Maximum reliability
- Minimum maintenance
- Reduced power consumption

*NOW IN COMMERCIAL PRODUCTION

Motorola's specialized research has provided transistors tailor-made for power utility applications. The potential 40,000-hour life of the transistor provides the ultimate reliability on a low maintenance, non-outage basis.

RELIABILITY

New *frequency-shift* power line carrier with unique Motorola hetrodyne transmitter and superhetrodyne receiver *has many advantages.* Transmits highest speed information at close 500 cycle spacing throughout the entire carrier band. This new equipment can assure maximum utilization of the carrier spectrum. Reduces power consumption up to 75%. Transmitter uses push-pull tubes in high reliability power output stage. Provides a superior communication medium for all telegraphic, keyed, and low frequency signals.

Motorola
frequency shift
POWER LINE CARRIER

Motorola Communications & Electronics, Inc.
A SUBSIDIARY OF MOTOROLA, INC.
4501 Augusta Blvd., Chicago 51, Ill.
Rogers Majestic Electronics Ltd., Toronto, Canada

Mail this Coupon Today

Motorola Communications and Electronics, Inc.
Dept. EWO, 4501 Augusta Blvd.
Chicago 51, Ill.

☐ Send more information on Frequency Shift Power Line Carrier.
☐ Have an Industrial Communications Engineer call.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

the features you want

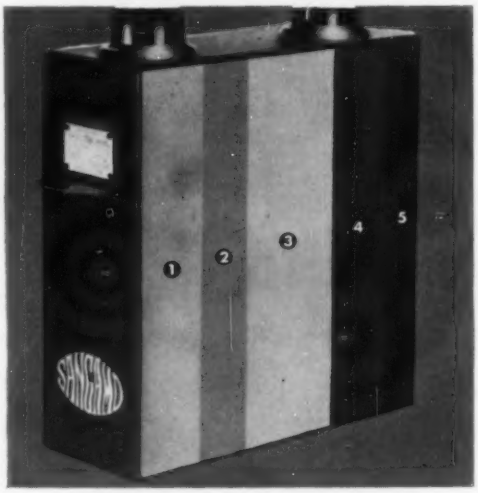
NEW Sangamo

The new Sangamo Power Capacitor combines features which result from efficient design, the use of materials developed by modern chemistry and metallurgy, and exact processing methods — all to assure performance stability.

COMPLETELY CORROSION-PROOFED CASE

Tin-plating of the steel case eliminates rusting during processing, and aluminum metallizing resists corrosive elements in service. Even if the external surface is scratched through to the bare steel the aluminum being anodic to the steel, provides electro-chemical protection. Here are the five steps required to give Sangamo's enduring case finish.

1. Case is tin-plated inside and out.
2. After impregnating and sealing, capacitor is sandblasted, preparatory to aluminizing.
3. Several coats of molten aluminum are sprayed on case.
4. Primer coat of vinyl-base resin paint is applied.
5. Final coat, also of vinyl-base resin paint assures a highly weather-resistant finish.



SOLDER-SEALED BUSHINGS

Bushings are permanently and hermetically bonded to the cover, a bond which is mechanically strong, too. The capacitor can be handled by the bushings without the slightest danger of loosening the seals.

TEMPERATURE STABILIZED IMPREGNANT

Sangamo's stabilized Diaclor will not congeal at the lower temperatures. Hence, Diaclor capacitors can be operated in switched or unswitched banks at temperatures as low as minus 40°C.

TIN-COATED PARALLEL GROOVE CONNECTORS

Copper or aluminum conductors—from #8 solid to #4 stranded — can be used. Tin-plating retards corrosion. Connections can be made without removing terminal nut.

STANDARD MOUNTING

Mounting dimensions have been standardized to enable mounting in NEMA standard hangers. NEMA standard one-unit, two-unit and three or four-unit hangers are available from Sangamo.

If you would like to know more about Sangamo Power Capacitors, write today for your copy of Bulletin 1120 or contact the Sangamo representative in your area.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

are built into the
Power Capacitor

Only the most modern equipment is used to make Sangamo Power Capacitors. A brand new "controlled conditions" plant has been built to make sure there can be no source contamination during manufacture. Process tests, factory acceptance tests, and capability tests safeguard the high quality level of Sangamo Power Capacitors and help to make sure that their service life is long and trouble-free.

NOW AVAILABLE IN THESE RATINGS

2400 Volts	25 KVAR
7200 Volts	25 KVAR
Single phase	60 Cycles

SANGAMO

PC55-2

STRONGER THAN THE PIN

In laboratory tests to determine the torsion strength of Kimble *Tempered* Glass Insulators, wood pins were sheared off, and lead-bushed threads stripped, with no failure of the Insulators. Cantilever tests using special alloy pins were discontinued at 10,000 lbs. with still no failure. Ultimate impact tests averaged 130 inch pounds!

Kimble *Tempered* Glass Insulators save installation time because it's never necessary to loosen for lineup with the conductor. Their great strength always allows another quarter-turn.

If it's on the pin, it's in service

Tests far in excess of A.I.E.E. standards have proved it impossible to puncture a Kimble *Tempered* Glass Insulator in air. Even lightning surges have failed to damage them. In the event of shattering due to severe mechanical shock, insulator disintegrates into small, non-sharp fragments. Trouble shooters can locate broken insulator—fast.

What's the secret? *Tempering*, a Kimble development in glass insulators that adds a new element to the many natural virtues of glass insulators. Kimble insulators are more than strong enough to meet the severe tests required.

Why not see how *tempered* glass can cut your line maintenance costs. Write for descriptive folder that gives complete details. Address: Kimble Glass Company, subsidiary of Owens-Illinois, Dept. EW-4, Box 1035, Toledo 1, Ohio.

KIMBLE INSULATORS
AN (O) PRODUCT

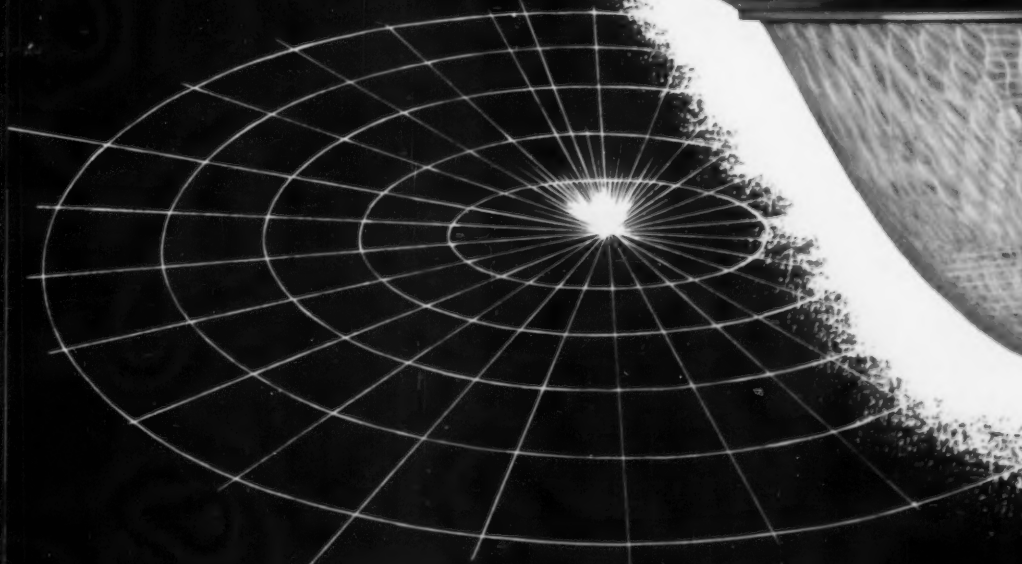
OWENS-ILLINOIS
GENERAL OFFICES • TOLEDO 1, OHIO

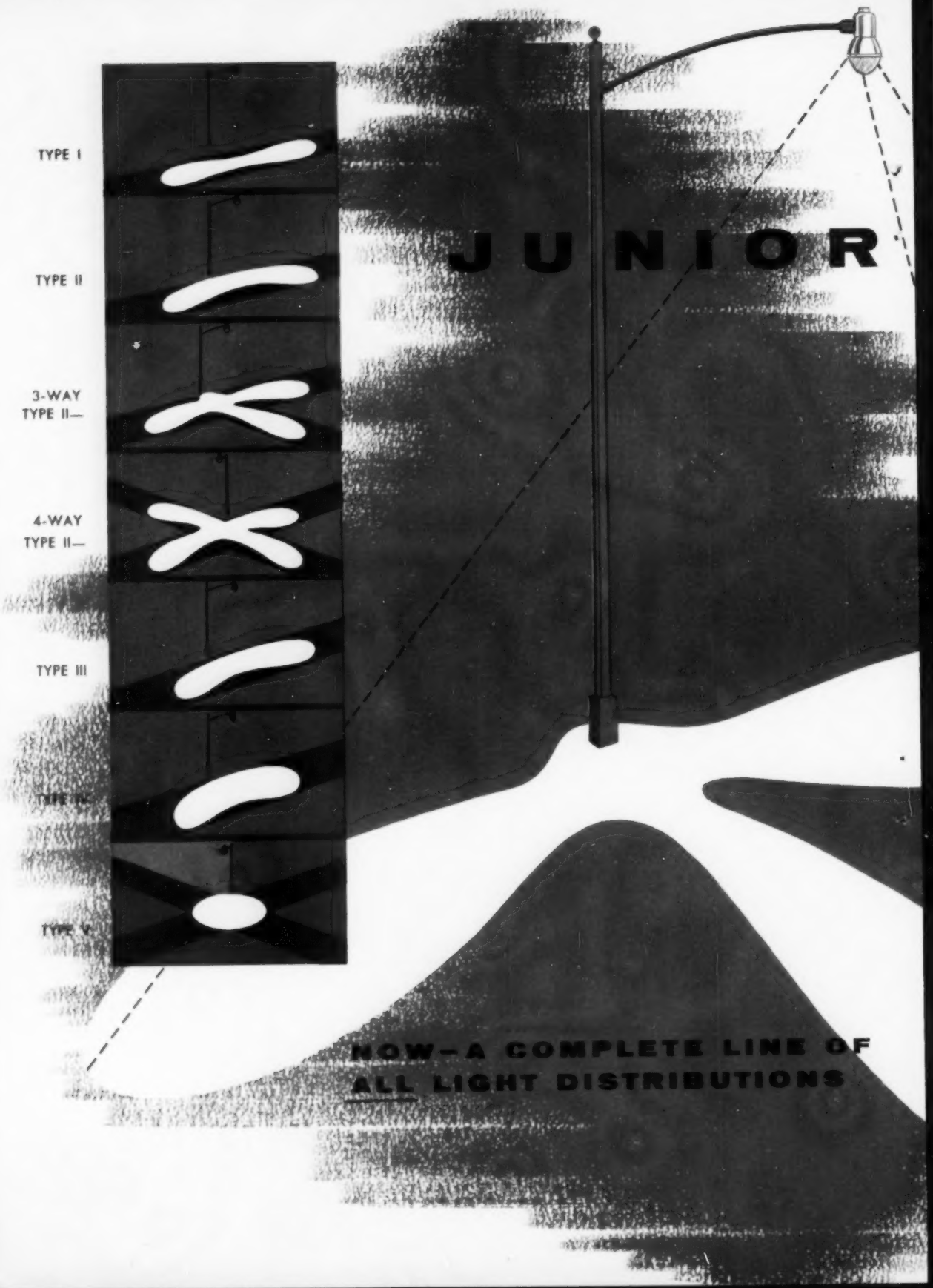
ALL TYPES OF

LIGHT DISTRIBUTIONS

Now Available With

JOSLYN




TYPE I
TYPE II
3-WAY
TYPE II—
4-WAY
TYPE II—
TYPE III
TYPE IV
TYPE V
JUNIOR
NOW—A COMPLETE LINE OF
ALL LIGHT DISTRIBUTIONS

JOSLYN

LUMINAIRES

Joslyn Junior Luminaires with Clear Rippled Globes:

I.E.S. Type IV	Catalog No. J60324F	Side of Street Mounting on Wide Streets
I.E.S. Type V	Catalog No. J60325F	Center of Street Mounting at Intersections

Above Catalog Numbers apply to Wedge Band Luminaires with [illegible] and with Medium Multiple Socket. Same [illegible] Numbers on following page.

Joslyn Junior Luminaires with Holophane Refracting Glassware:

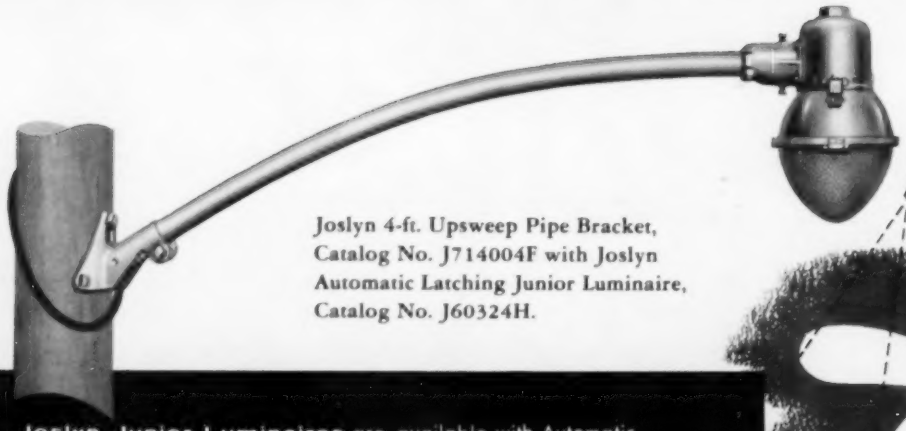
I.E.S. Type I	Catalog No. J60321F	Center of Street Mounting on Narrow Streets
I.E.S. Type II	Catalog No. J60322F	Side of Street Mounting on Narrow Streets
I.E.S. Type III	Catalog No. J60323F	Side of Street Mounting on Medium Width Streets
3-Way I.E.S. Type [illegible]	Catalog No. J60327F	For Use at 3-Way Intersection
4-Way I.E.S. Type [illegible]	Catalog No. J60328F	For 45° Mounting at 4-Way Intersection

Joslyn [illegible] can also be furnished with Automo[illegible] glassware in any light distribution

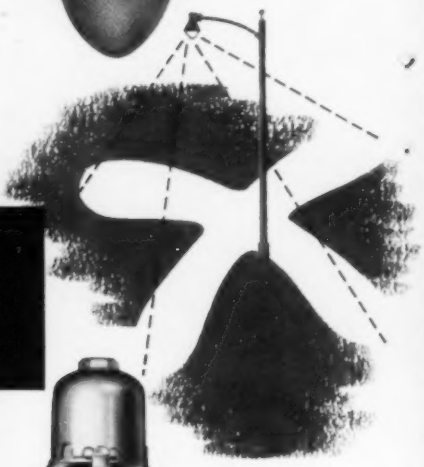
All Junior Luminaires with Style 30 or 60 Heads of Die Cast Aluminum are suitable for operation on Multiple Circuits with 2500 Lumen Incandescent Lamps.

JOSLYN MFG. AND SUPPLY CO.

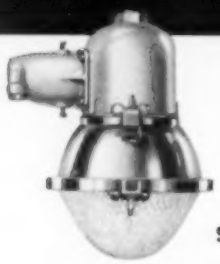
Chicago



Joslyn 4-ft. Upsweep Pipe Bracket, Catalog No. J714004F with Joslyn Automatic Latching Junior Luminaire, Catalog No. J60324H.

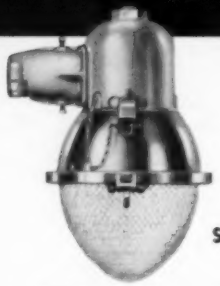


Joslyn Junior Luminaires are available with Automatic Latching Glassware as shown on this page—just use subscript "H" in place of "F" in the catalog numbers shown on preceding page.



Style 60

Junior Automatic Latching Luminaire Catalog No. J60322H



Style 60

Junior Automatic Latching Luminaire Catalog No. J60324H

Style 30

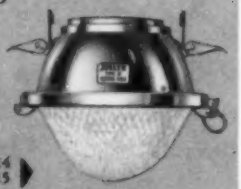
Junior Luminaire With Rippled Globe Catalog No. J30325H

Catalog Numbers of Reflector—Glassware Assemblies

For Wedge Band Luminaires

With Holophane Refractors		With Rippled Globes	
I.E.S. Type I	J810121	I.E.S. Type IV	J810124
I.E.S. Type II	J810122	I.E.S. Type V	J810125
I.E.S. 4-Way Type II	J810126		
I.E.S. 3-Way Type II	J810127		
I.E.S. Type III	J810123		

Stainless Steel Wedge Band..J905011

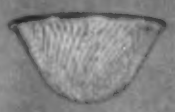


For Automatic Latching Luminaires

With Holophane Refractors		With Rippled Globes	
I.E.S. Type I	J810621	I.E.S. Type IV	J810624
I.E.S. Type II	J810622	I.E.S. Type V	J810625
I.E.S. 4-Way Type II	J810626		
I.E.S. 3-Way Type II	J810627		
I.E.S. Type III	J810623		

Glassware Holding Ring.....J905029

Catalog Numbers of Glassware for Junior Luminaires



I.E.S. Type I	J904004	I.E.S. Type III	J904007
I.E.S. Type II	J904002	I.E.S. Type IV	J904008
I.E.S. 4-Way Type II	J904001	I.E.S. Type V	J904008
I.E.S. 3-Way Type II	J904001		

JOSLYN MFG. AND SUPPLY CO.

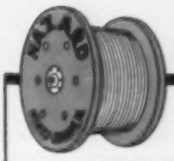
Chicago, Illinois

and for the same reason: It's MOLD-CURED

All rubber floor coverings have to be vulcanized in a metal mold—mold-cured. It's the only way they can survive the punishment handed out by the hundreds of ton-miles of grueling wheel and foot traffic that is daily routine for most industrial installations. The toughness and resilience that only mold-curing can guarantee are the secret of rubber floors that wear on, not out.

Long-lived Hazacord cables have to be mold-cured, too; and they are. Bending, twisting, flexing, scraping, dependable portable cable service demands the toughness and durability that mold-cured Hazacord guarantees. Even, thorough vulcanization in a metal mold yields a compact cable assembly that is strong yet flexible, tough yet workable. And the Hazaprene ZBF sheath is permanently effective protection against flames, acids, alkalies, oils and moisture.

For any portable installation up to 15,000 volts, there is a mold-cured Hazacord construction that will save you money and trouble. Ask your jobber or your nearest Hazard representative or write for Bulletin H-451, Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.



2145

HAZACORD

Mold-Cured

portable cables

PRODUCT OF OKONITE RESEARCH

Roller-Smith

PROUDLY ANNOUNCES the

NEW...

UNI-BUS BUSWAY

A New Concept in busway systems that obsoletes all other methods of carrying current.

- Low Voltage Drop in ***PLUG-IN*** AND ***FEEDER*** TYPES.
- High Short Circuit Strength in ***PLUG-IN*** AND ***FEEDER*** TYPES.
- ***ONE FLEXIBLE FITTING*** makes elbows, offsets —simplifies engineering and eliminates costly delays.
- ***COMPLETE SAFETY*** because live bus bars at plug outlets and live connections in plugs are eliminated.

And All at Lower Cost!

Roller-Smith
CORPORATION
ELECTRICAL SWITCHGEAR
BETHLEHEM, PENNSYLVANIA

ECONOMY

New slip-on hangers and lighter weight busway mean less installation time. Feeder system often costs less than conduit and wire, yet is 100% reusable.

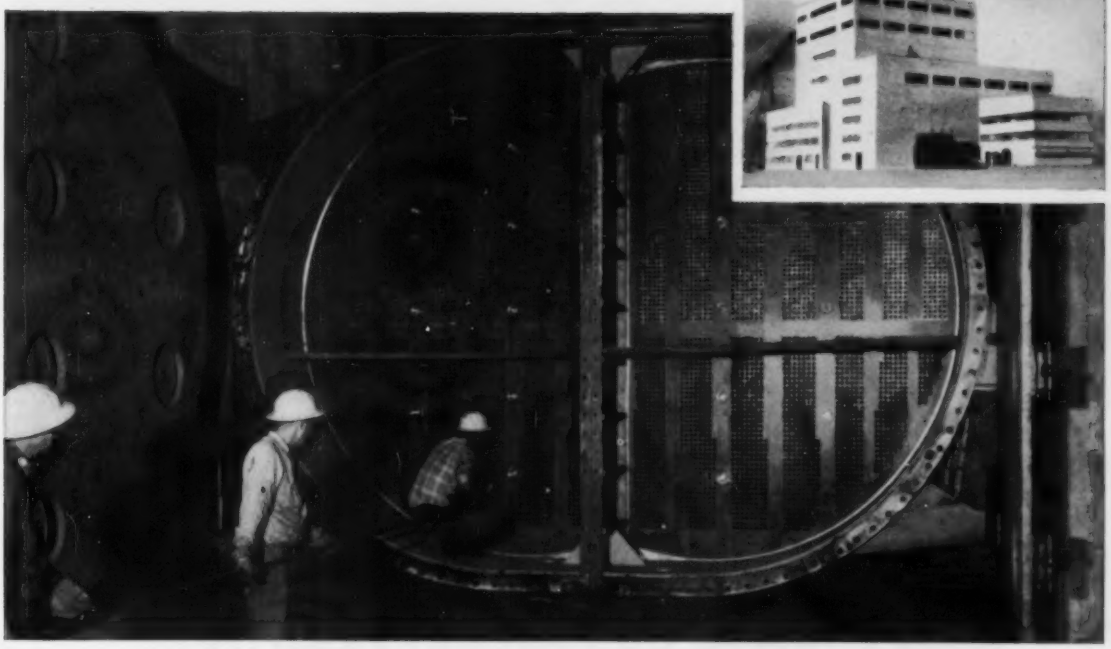
FLEXIBILITY

Flexible connector eliminates all special fittings so that a minimum number of components meet all job requirements. Plug-in and feeder systems interchangeable.

SAFETY

Interlocked safety slide over plug outlet cannot be opened until covered by plug. Interlocked cover and visible contacts in plug are positive assurance of safety.

LONG LIFE AHEAD!



Wisconsin Power and Light Co. looks to the future with Chase® Condenser Tubes!

To guarantee years of efficient, trouble-free condenser service, Wisconsin Power and Light Co. called on Chase to supply the 6,419 Antimonial Admiralty condenser tubes needed in their new Rock River station.

Chase Antimonial Admiralty contains the *right* amount of antimony needed to withstand dezincification. What's more, the uniform grain size and excellent grain structure of Chase Antimonial Admiralty means that Chase tubes are rugged enough to stand up under heavy stresses in the field.

Chase can help you supply dependable, low-cost electricity—by adding extra years to condenser life. Write today for free Chase Condenser and Heat Exchanger Tube Booklet.

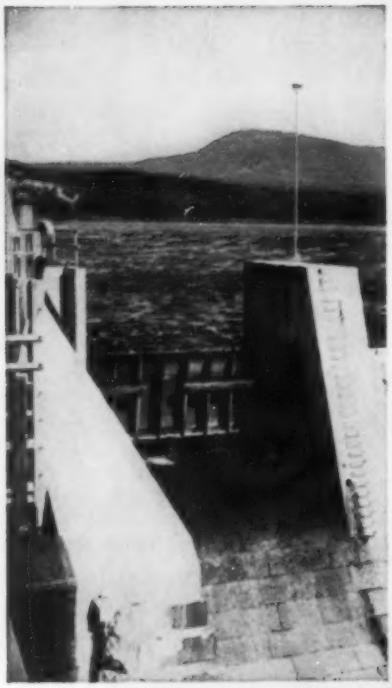
Chase®

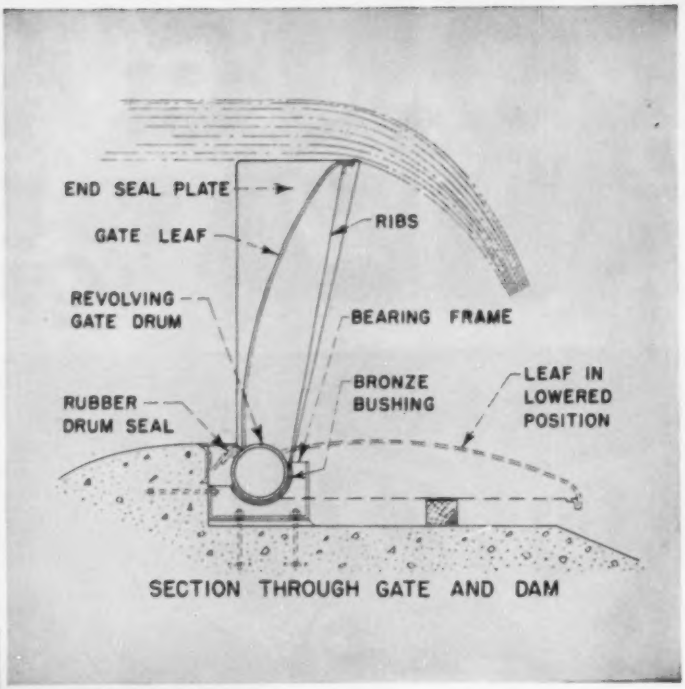
BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany†	Chicago	Detroit	Los Angeles	New York	St. Louis
Atlanta	Cincinnati	Grand Rapids†	Milwaukee	Philadelphia	San Francisco
Baltimore	Cleveland	Houston	Minneapolis	Pittsburgh	Seattle
Boston	Dallas	Indianapolis	Newark	Providence	Waterbury
Charlotte†	Denver	Kansas City, Mo.	New Orleans	Rochester†	(†sales office only)





SECTION THROUGH GATE AND DAM

SMS

BASCULE CREST GATES

DO YOU NEED MORE WATER STORAGE— MORE CONTROL OR SPILLWAY CAPACITY...

Raising the water level is often the most economical way to meet increased demands on water and power supply. This problem can be quickly and economically solved on existing dams with a Bascule Crest Gate. Advantages of the SMS-Bascule are the speed and ease of operation for flood control and for sluicing away debris and ice.

SMS-Bascule Gates are electrically or hydraulically operated by automatic and/or manual controls.

According to your needs, gates can be made in lengths up to 100 ft. and up to 10 ft. in height.

Hydrodynamics has been our specialty for over 75 years. For more information on hydraulic turbines, bascule gates and other accessories, write to the S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories

HYDRODYNAMICS

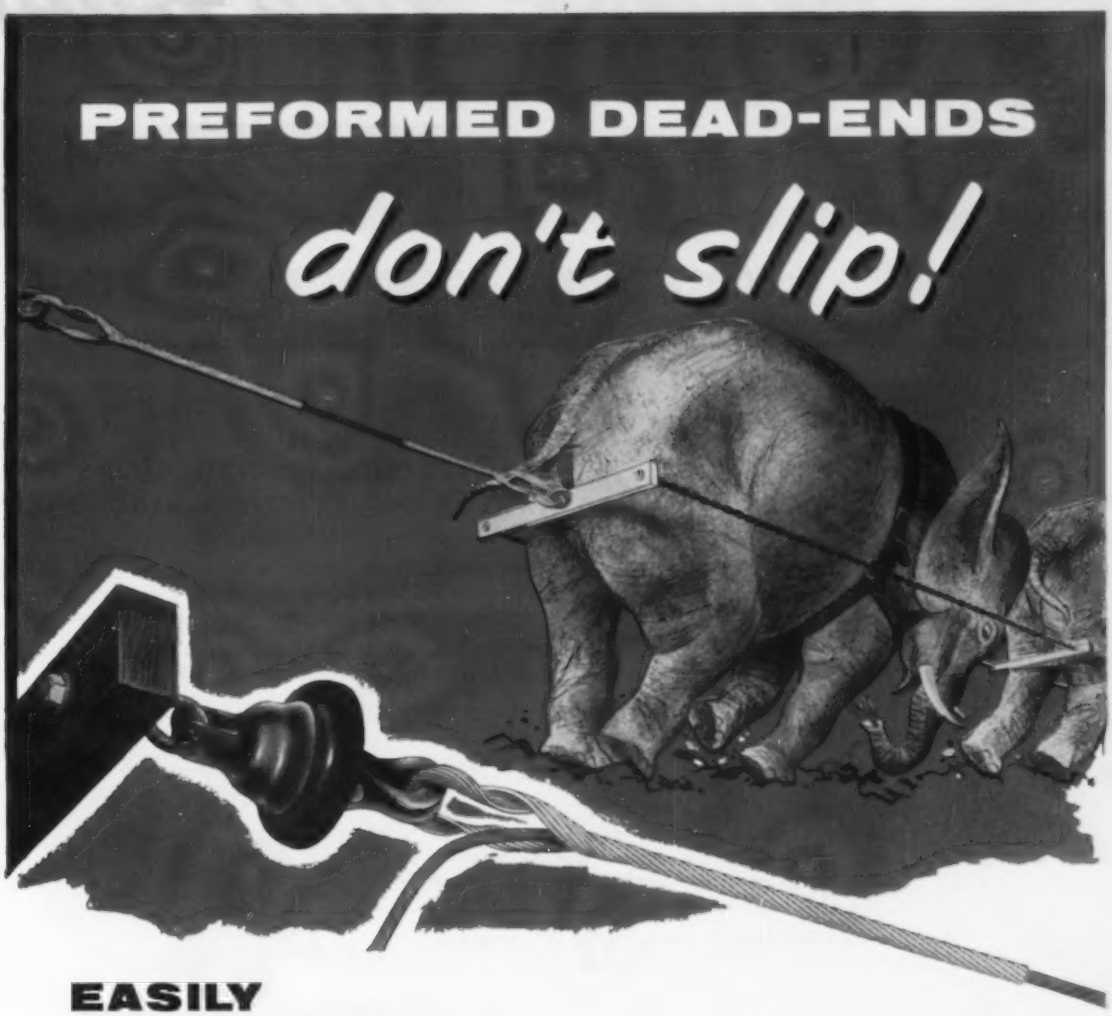
Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH CANADA, LIMITED, TORONTO

PREFORMED DEAD-ENDS

don't slip!



EASILY INSTALLED! Guard against damaging high concentrated pressures at dead-ends . . . avoid outages with Preformed Dead-Ends. They firmly hold the conductor snugly and securely with a "velvet-glove" grip. Make them your standard dead-end for both insulated and bare conductors.

They are the easiest installed dead-ends you've ever used. Proved by extensive tests, both in the laboratory and in the field, Preformed Dead-Ends withstand tremendous strain even under constant intermittent loading conditions.

Prove to yourself that they are outstanding—both in service life and economy. Write or call for more facts. Telephone Cleveland: EX-1-3571.

PLP

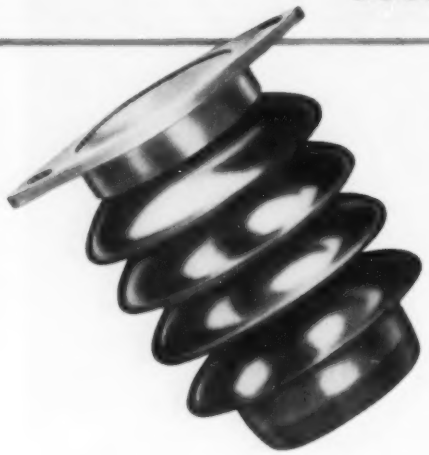
PREFORMED LINE PRODUCTS COMPANY

5349 ST. CLAIR AVENUE • CLEVELAND 3, OHIO

IMPROVE YOUR THIRD

with

BOOST SAVINGS IN ENGINEERING, EQUIPMENT,



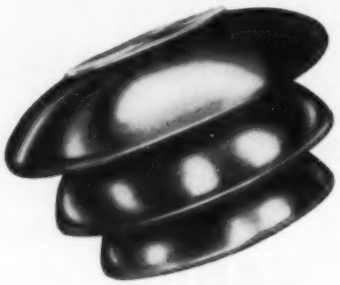
PETTICOAT INSULATORS FOR THIRD RAIL SERVICE TO 4160 VOLTS

HIGH MECHANICAL STRENGTH, with tensile and cantilever properties for heavy-duty over or under-running applications. Extra heavy petticoats to stand industrial abuse.

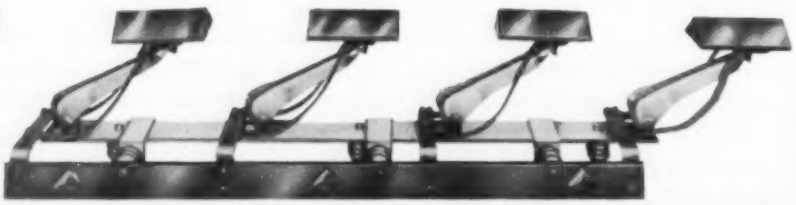
QUALITY MATERIALS, using high grade wet process, glazed porcelain to assure permanent efficiency.

UNSURPASSED ELECTRICAL PROPERTIES, with extra leakage distance and self cleaning surface to lessen effect of contaminations leading to shutdowns. Petticoat insulators also recommended for dirty low voltage systems.

ALL PURPOSE HARDWARE available for rail, angle or wire service.



NEW



COLLECTORS FOR UNDER-RUNNING CONTACT SYSTEMS

HIGH AMPERAGE . . . collector arms used in multiple units for high capacity (2400 amp. shown).
DEPENDABLE . . . contact surface protected against sleet and dirt; bearings sealed against grit.
LONG LIFE, HEAVY DUTY . . . vital parts are stainless steel; contacts are extra large.
NON-ARCING BEARINGS . . . integral insulating bushings insure current transfer through shunts.
WIDE OPERATING RANGE . . . will accommodate vertical and horizontal misalignments.

ELECTRIC SERVICE MFG. CO.

RAIL INSTALLATIONS

KEYSTONE PRODUCTS

INSTALLATION, MAINTENANCE AND PRODUCTION

STRAIN INSULATORS FOR CRANE BRIDGE ANGLES

This new insulator now TOPS in the field.

- **SMALLEST SIZE: 2" diameter; accommodates smaller angles and permits closest conductor spacings.**
- **FUNCTIONAL SHAPE: small end provides extra clearance for collector.**
- **LONGER LEAKAGE DISTANCE: reduces possibility of shut-downs due to contamination.**
- **INSULATORS COST LESS than wooden supports.**
- **STEEL INSULATOR INSERTS are free of shrinkage . . . never vibrate loose.**
- **HIGH STRENGTH — tensile and cantilever — minimizes breakage.**
- **STRAIN HARDWARE available for all insulators.**

XVE "*Econo-Mizer*" CRANE COLLECTOR FOR PICK-UP WIRE SYSTEMS

The XVE "Econo-Mizer" crane collector. Includes all advantages of strain insulator above, plus . . .

- **NEW LOW COST: entire assembly costs less than castings alone for other type collectors.**
- **MULTIPLE SAVINGS: replacement of complete body assembly is quicker . . . easier . . . cheaper than repairing.**
- **LONGER SERVICE: carbon contacts give greater life and reduce arcing. Graphite lubrication prolongs wire life.**
- **INTEGRATED CONTACT electrically bonded to collector body for uniform efficiency; shaft is permanent part of insulafor.***
- **COMPACT: designed for closest wire spacings.**

***Collector also available without insulator.**

Photo: Actual Size

Write for details on these third rail system improvements

Philadelphia 32, Pa.

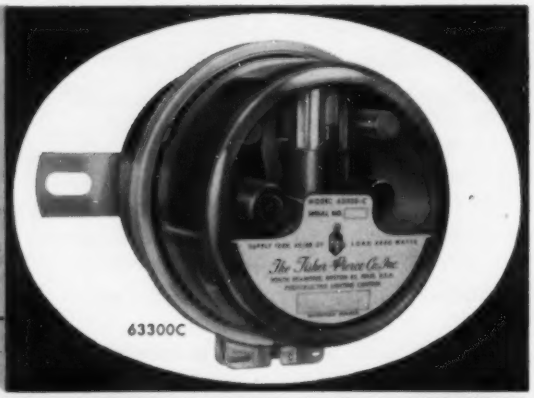
FISHER-PIERCE
PHOTOELECTRIC CONTROLS

for every lighting system requirement

The extreme versatility and quality of Fisher-Pierce photoelectric lighting controls is evidenced by their widespread use over the past eight years, in controlling hundreds of street lighting systems . . . aircraft obstruction and beacon lights . . . outdoor signs and store window lights . . . parking, loading and storage area lights . . . poultry house and roadside telephone illumination, etc. All Fisher-Pierce controls employ a basic circuit whose dependability, ruggedness and trouble-free performance have been proven in use.

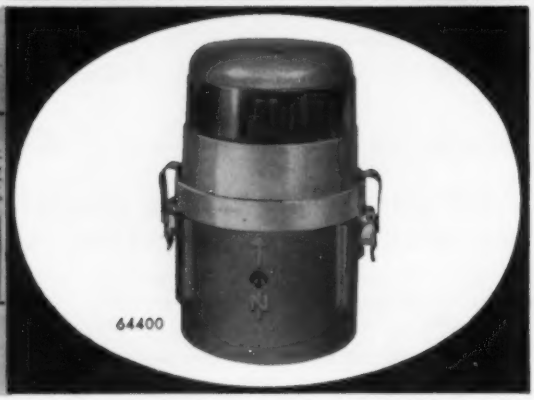
SERIES 63300C CONTROLS

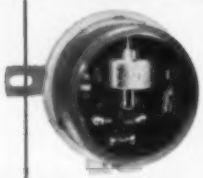
Rugged, easily installed, accessible units for switching up to 3000 watts of lighting load. For operation at 105-130 or 210-250 V, 50-60 cycles. Standard models come with SPST, SPDT, or DPST power contactors. Special models are available with a switching capacity of 6000 watts. The electronic chassis is enclosed in a weatherproof watt-hour meter case assembly which plugs into a standard meter socket. The new 63300C design represents the results of eight years' extensive, specialized experience in the field.



SERIES 64400 CONTROLS

Small, compact, low cost units for switching 1000 watts of incandescent, mercury or sodium vapor lamps at 120 V, 50-60 cycles. Designed for use as an integral part of various manufacturers' luminaires, as well as for ballast, pole top, cross arm, standard and other mountings. Low initial cost and low maintenance make the use of one Series 64400 control per lamp economically practical for new street lighting installations and isolated locations.





MULTIPLE RELAYS FOR SWITCHING LOW VOLTAGE OUTDOOR LIGHTING CIRCUITS

Fisher-Pierce multiple relays incorporate a maintenance-free mercury plunger relay conservatively rated to switch 30 amps. at 110-115 volts AC. Series 100 relay is housed in a standard meter case and is available with or without line and coil protective equipment. The low cost Series 200 (not shown) is housed in a weatherproof cast aluminum case. Both series are designed for outdoor use as pilot wire control or for cascading street lighting circuits. Available with normally open or normally closed relays.

THE ***nitelighter***

. . . for automatic control of home lights

An inexpensive, compact, automatic control made especially for domestic use. Operates on 110 volts AC, switches up to 300 watts. Plug lamp to be controlled into NITELIGHTER plug, face "eye" toward window; living room, hall, garage lights, etc. go on at dusk, off at dawn automatically and without attention. You'll never come home to darkness. Protects the home when you're away. Get it at your dealer, or if he cannot supply you, send a check or money order for $13.95. A NITELIGHTER will be sent postpaid and insured.

Complete Specifications and Data Available on Request

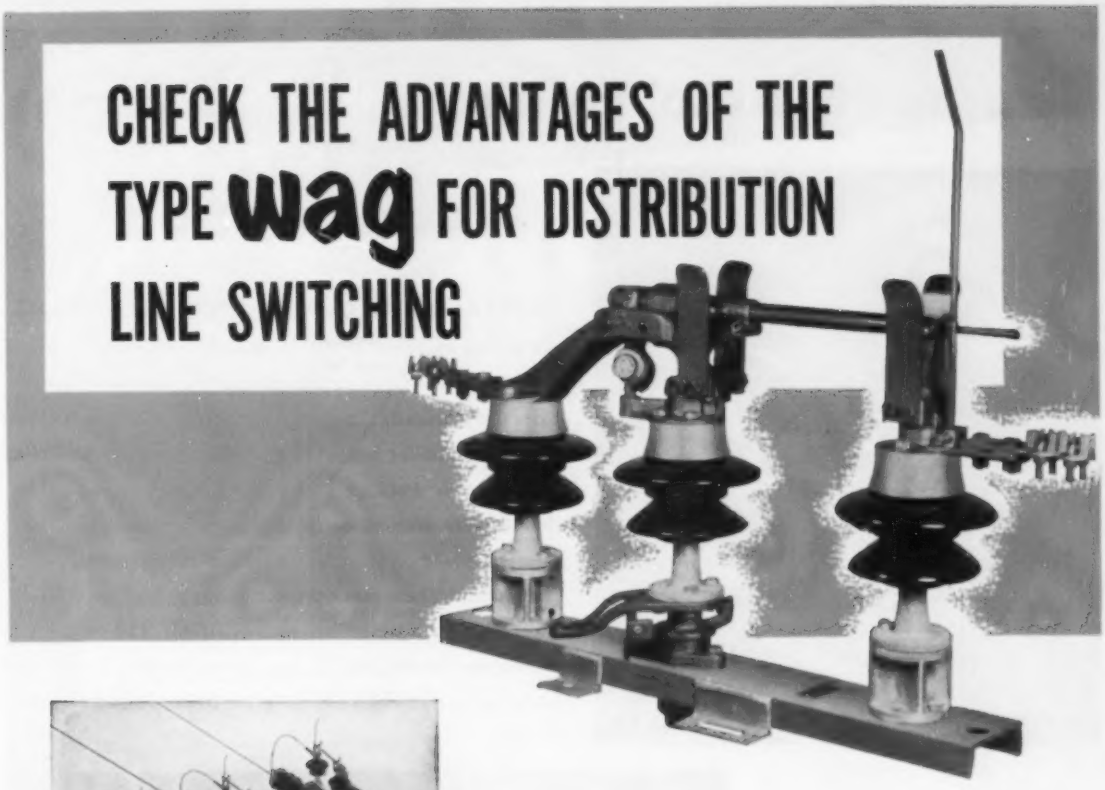
THE FISHER-PIERCE COMPANY, INC.

82 Pearl Street, So. Braintree, Boston 85, Mass.

EXPORT: PHILLIPS EXPORT CORP. DIVISION OF NORTH AMERICAN PHILLIPS 100 E. 42ND STREET NEW YORK 17, N. Y.

IN CANADA: NORTHERN ELECTRIC CO., Ltd.

CHECK THE ADVANTAGES OF THE TYPE WAG FOR DISTRIBUTION LINE SWITCHING



OKLAHOMA—This photo shows Type WAG switches on standard switch frame, pole-top mounted.

STANDARD SWITCH FRAMES OR STEEL CROSS ARMS

with standard controls are now available *in stock* for pole-top mounting of Type WAG in conventional manner. For further information on this inexpensive method of mounting, write direct to factory or ask your Southern States representative. The WAG is also designed for mounting on wood cross arms.

Is it a profitable practice to use premium-type WAG Air Break Switches for distribution line switching? The answer is a resounding *yes*, if the experience of utilities throughout the nation is any criterion. A check of the advantages will tell you why:

Complete Dependability—High contact pressure and wide contact deflection combined with heavy construction make the distribution level Type WAG particularly reliable under all service and climatic conditions. With short circuit capacities on the increase, it is your best choice!

Trouble-Free Service—Shuntless construction, a simple system of controls, only three moving elements, and greaseless bronze ball bearings add up to make the WAG virtually trouble free. Install it! Forget it!

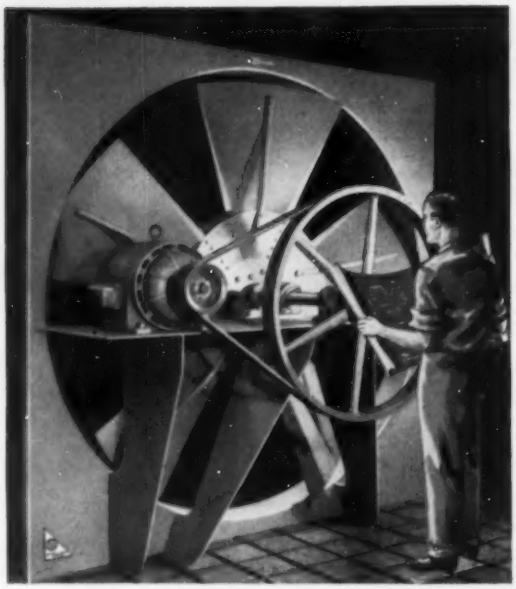
Ease of Operation—A simple system of cranks and levers arranged to provide the most favorable mechanical action is the secret of its smooth, positive operation—even under a heavy coating of ice.

The Type WAG is ideal for sectionalizing, disconnecting or by-passing. Get full facts from your Southern States representative, or write for Bulletin No. 390-R, and you'll specify Type WAG Switches for your distribution systems, too.

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

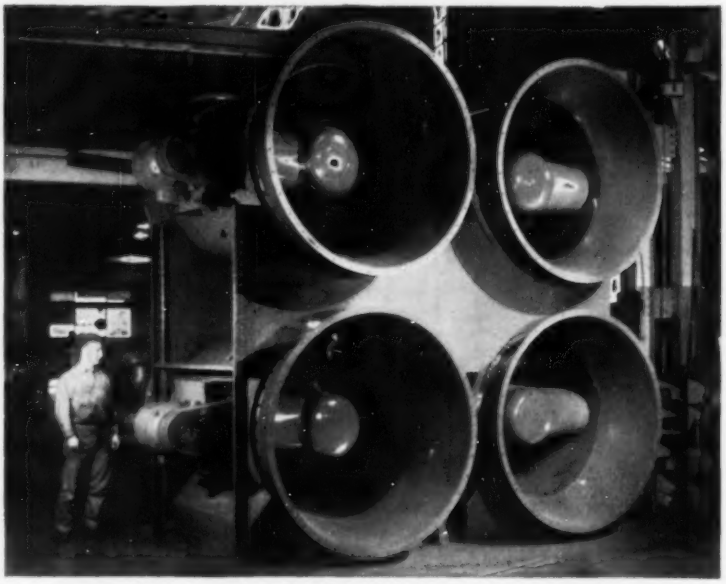
YOU DON'T NEED TO BROIL IN THE BOILER ROOM!



"BUFFALO" PACKAGE PROPELLER FANS are giving excellent results in removing excess heat from boiler rooms of large utility stations and industrial power plants — efficiently "moving out" large volumes of hot air to make boiler rooms cool, pleasant places to work in. The large 96" Package Propeller Fan shown is typical of the unusual efficiencies in this popular "Buffalo" line. Moving 80,000 cfm at ¼" static, it requires only a 15 H.P. motor. These fans operate against as high as 1" pressure, and sizes range up to 144" (this 12-foot wheel delivering 250,000 cfm!). For the economical answer to boiler room cooling, write today for BULLETIN FM-1234.

"BUFFALO" AXIAL FLOW FANS, too, are becoming increasingly popular with power plant operators because of their extremely high efficiency, light weight and suitability for duct mounting. If practical, heated air from the boiler room may be distributed to other areas by duct. These fans have the "Limit-Load" horsepower characteristic — they cannot be overloaded. At right is a 4-fan "package" unit now effectively cooling a prominent power plant. WRITE FOR BULLETIN 3533-C. In all "Buffalo" Fans, you get a built-in value known as the "Q" Factor* — the product of 78 years of air handling experience.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*



"BUFFALO" ALSO BUILDS the Induced Draft, Forced Draft, Primary Air, Gas Recirculating and other Fans that are helping to produce economical power for many of the country's best-known installations. WRITE FOR BULLETIN 3750.

"Buffalo"

BUFFALO FORGE COMPANY

212 MORTIMER ST. BUFFALO, N. Y.

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ontario

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

What to look for when buying

SPORTS FLOODLIGHTS

Some floodlights give you more for your money than others. Make sure you get *all* the time-tested features that mean easier installation . . . less service trouble . . . longer operation . . . greater economy over the years. Before buying any floodlight, ask yourself these questions . . .

• Cut out and save this technical guide

FEATURES	CROUSE-HINDS TYPE FLA	Mfr. A	Mfr. B	Mfr. C	Mfr. D	Mfr. E	Mfr. F
1. Does it have a backdoor for easier lamp replacement and cleaning?	Yes	Yes	No	Yes	Yes	Yes	No
2. Is there a sight on the axis for more accurate aiming?	Yes	No	No	Yes	No	Yes	No
3. Are the door catches adequate for permanent weather-tightness?	Yes	Yes	Yes	No	Yes	Yes	No
4. Is the floodlight wired, eliminating additional costs?	Yes	Yes	Yes	No	Yes	Yes	No
5. Is the socket shell plated to prevent corrosion and lamps "freezing" in?	Yes	Yes	Yes	Yes	No	No	Yes
6. What is the socket temperature? (UL maximum safe operating temperature 200°C)	185°C	230°C	226°C	227°C	269°C	211°C	259°C
7. What is the cable temperature? (to minimize insulation deterioration)	135°C	181°C	202°C	150°C	231°C	173°C	195°C
8. Is the lens heat-tempered to prevent breakage?	Yes	Yes	Yes	Yes	Yes	Yes	No
9. Will the Floodlight withstand the UL rain test?	Yes	Yes	Yes	Yes	No	No	No
10. Are the gaskets adequate for permanent weather-tightness?	Yes	Yes	No	Yes	Yes	No	No
11. Is the floodlight rigidly constructed for longer life and accurate aiming?	Yes	Yes	Yes	No	Yes	Yes	No
12. Can you rotate the wire entrance to simplify wiring?	Yes	No	No	No	No	No	No
13. How many beam spreads are available and what are their efficiencies?							
—14°	45.3%	N.M.†	N.M.	N.M.	N.M.	N.M.	N.M.
—20°	44.9%	43.5%	43.8%	41.2%	N.P.‡	N.P.	N.M.
—35°	48.6%	50.3%	49.1%	50.5%	45.2%	N.P.	38.6%
—50°	50.2%	N.M.	N.M.	N.P.	N.M.	N.P.	N.M.
—80°	57.8%	56.3%	58.4%	N.P.	N.P.	N.P.	60.3%

†N.M. Not made by this company. ‡N.P. Not published.

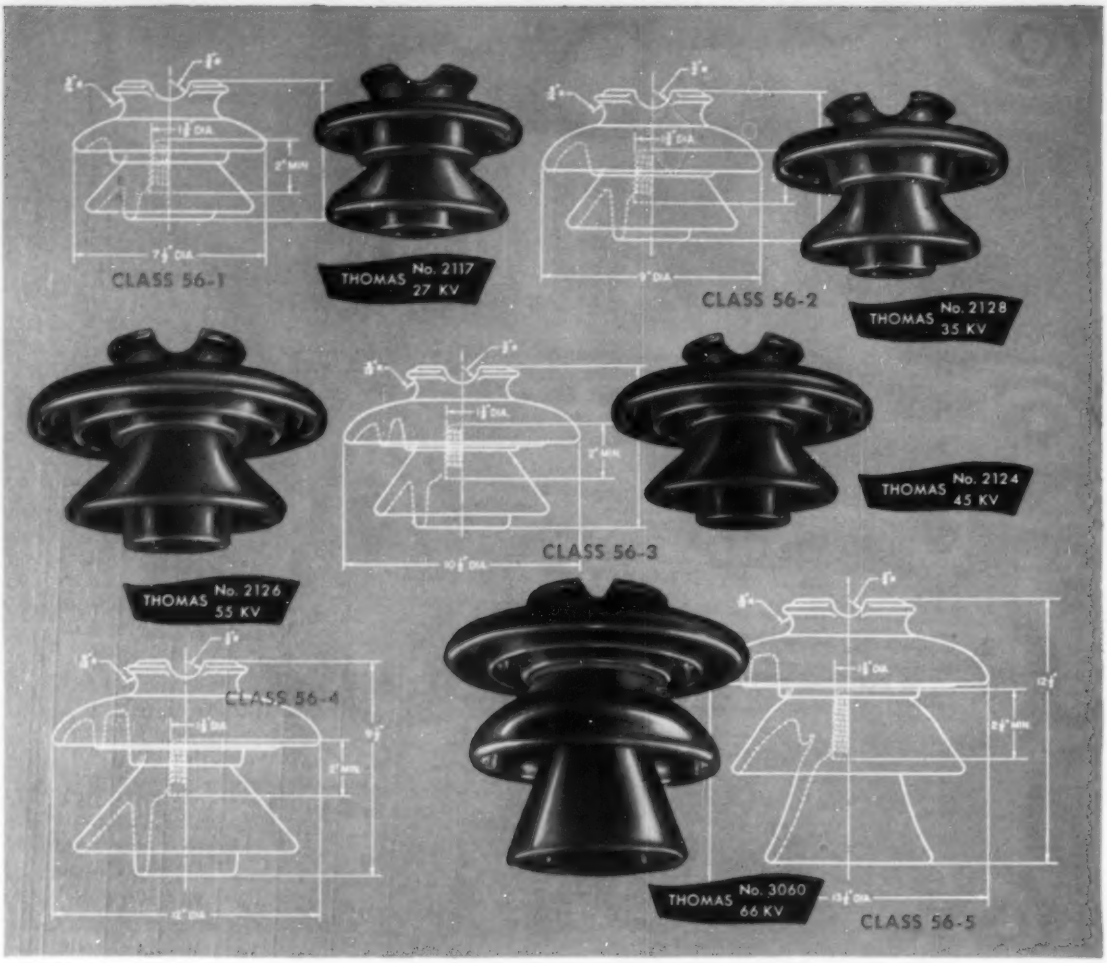
• Crouse-Hinds' illumination engineers will be glad to discuss your floodlighting problems with you at your convenience. Free Bulletin containing sports floodlighting layouts for all night sports and complete specifications of type FLA floodlights sent on request.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

SYRACUSE 1, N. Y.

FLOODLIGHTS • CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING



THOMAS makes all Five

EEI-NEMA STANDARDS show five designs of high-voltage pin-type insulators. Although we catalog 10 high-voltage pin-type designs, we are 100% behind any standardization that we believe helps the Industry. Therefore, we suggest that Users specify the five EEI-NEMA Standards for their high-voltage pin-type requirements.

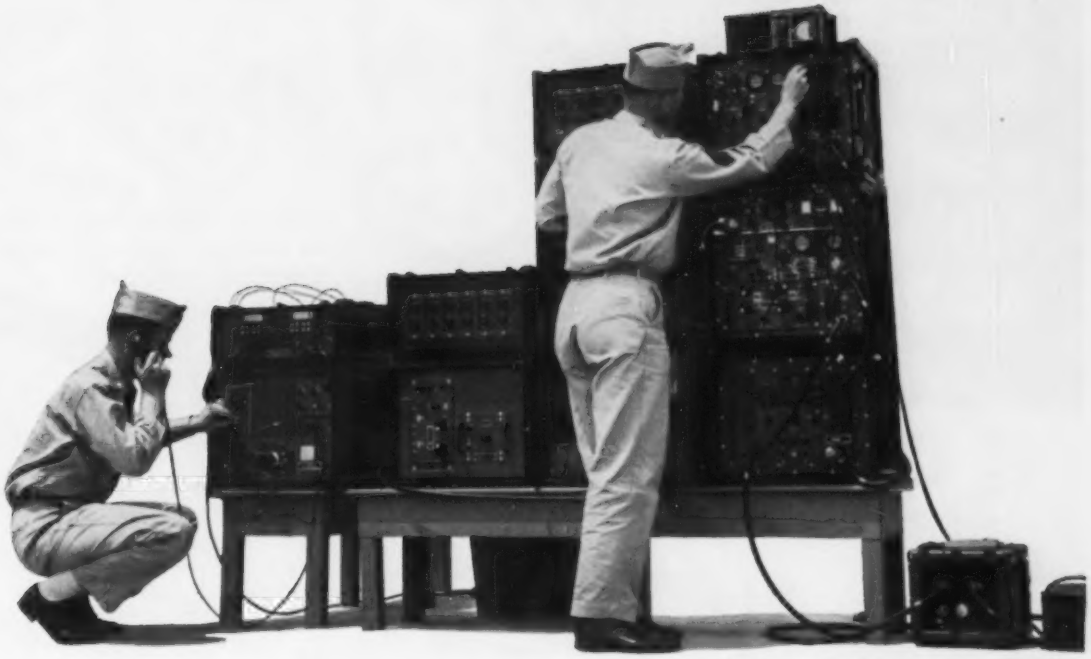
Thomas insulators are backed by 82 years of ceramic experience and knowledge. Quality materials, precision manufacturing and PROOF OF PERFORMANCE make THOMAS porcelain the standard of comparison for discriminating engineers throughout the Electrical Industry.

Specify Thomas EEI-NEMA STANDARDS for your porcelain requirements. These Insulators are offered with the Thomas, Patented, Noise-Free, under-glaze treatment at no extra cost. Simply specify the catalog number with the suffix "Q-T."

The R. Thomas and Sons Co.

LISBON, OHIO

1873 THOMAS INSULATORS our 82nd year RELIABILITY 1955



Tuning in for radio transmission. Each item of equipment is not much bigger than a suitcase.

A leapfrog telephone system for the Armed Forces!

A new communications system, which takes to the air when water or rough terrain prevents the stringing of wires, has been developed for the U.S. Signal Corps by Bell Telephone Laboratories.

The system uses cable and radio relay interchangeably over a 1000-mile range. It is easily portable, unaffected by climate, and rugged enough for global use. Twelve voices travel at once over a pair of wires or radio waves—as clearly and naturally as over the regular telephone system.

This is the first time a completely integrated wire and radio system of this large a channel capacity has been available for tactical use by the Armed Forces. It is already in production at Western Electric, manufacturing and supply unit of the Bell System.

The new system is a joint achievement of the Signal Corps, Bell Laboratories and Western Electric . . . one of the many results of long and fruitful co-operation. It shows again how techniques which the Laboratories develop contribute to our national strength.

Amplifiers like this are used every 5¾ miles in the cable portions of the system. They are weatherproof, can be used on a pole or the ground, and will even work under water. The system uses a spiral wound cable developed by the Signal Corps.

Easily raised antennas send or receive for the radio links.

Bell Telephone Laboratories

Improving telephone service for America provides careers for creative men in scientific and technical fields

Cross arm warpage is no problem with a self-aligning Tilting Insulator AG-20 Switch

POWERFUL ICE-BREAKING ACTION
The blade pivots on pin (3) before opening movement begins

Silver to silver contacts

Braidless front contact

HERE'S HOW 3E GIVES TIGHT CLOSURE EVEN WHEN THE SUPPORT IS WARPED

1. **Wide rounded contact for easy entry**
2. **Ample lateral motion**
3. **Blade pivots on full-floating pin for rocking action**

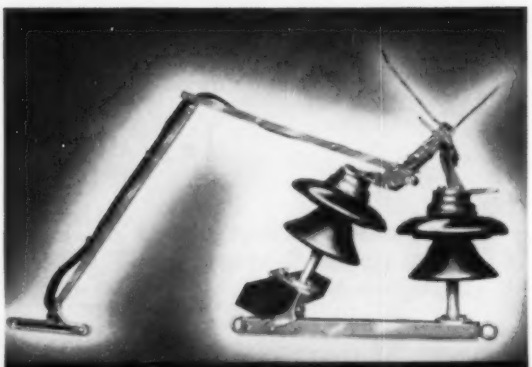
If you are looking for safe, sure, low cost switchgear . . . the 3E Tilting Insulator Switch is the answer. It can be easily and quickly installed . . . will align itself and operate effectively regardless of the pole's condition.

For complete details write for Bulletin No. 323

THREE & 3E

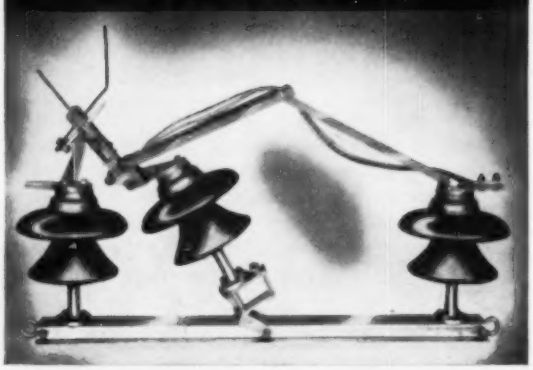
ELECTRICAL ENGINEERS EQUIPMENT CO.

MELROSE PARK, ILLINOIS



34.5 KV, 400 Ampere, switch

34.5 KV, 400 Ampere, switch



The Ansul dry chemical fire equipment pictured above includes portable hand units, wheeled and stationary units and a jeep installation. Ansul also manufactures automatic dry chemical piped systems, custom engineered for the hazard. Ansul equipment is listed and approved by Underwriters' and Factory Mutual Laboratories.

Only Ansul offers a Five Year Equipment Warranty

Your assurance of fast, dependable fire protection

For you, the buyer of fire equipment, Ansul's important 5 year warranty means many extra years of fast, dependable protection. It also means freedom from costly maintenance checks and repairs.

Special design and construction features make this warranty possible. Ansul's *weather-tight* construction keeps out moisture, resists corrosion. *Patented nozzles* deliver the right kind of stream for your hazard. A *sealed pressure cartridge* puts Ansul's "Plus Fifty" dry chemical to work immediately—no delay or lag. Finally, *rugged construction* makes it possible for Ansul equipment to give peak performance under the toughest operating conditions.

Call the Ansul Man!

Get in touch with your local Ansul man through the "yellow pages" or write ANSUL CHEMICAL COMPANY, Fire Equipment Division, Dept. F-153 Marinette, Wisconsin. *Write Ansul for your copy of new Fire Equipment Catalog.*

ANSUL

FOR A **high conductivity joint**

Use

KEARNEY

SERVICE ENTRANCE SLEEVES

. . . They Squeeze On in Seconds

Here's how to help your crews make faster, neater and more dependable service entrance hook-ups. KEARNEY Service Entrance Sleeves are designed and engineered to make quick connections that cannot loosen.

These sleeves are available in sizes to fit all commonly used conductor combinations. Sizes are instantly identified by the color-coded plastic caps that seal KEARNEY's Conductive Paste inhibitor (Kearnaline) into every sleeve.

Just a few indents with KEARNEY's specially designed hand tool and one man will make perfect connections easily . . . better connections than with older type connectors.

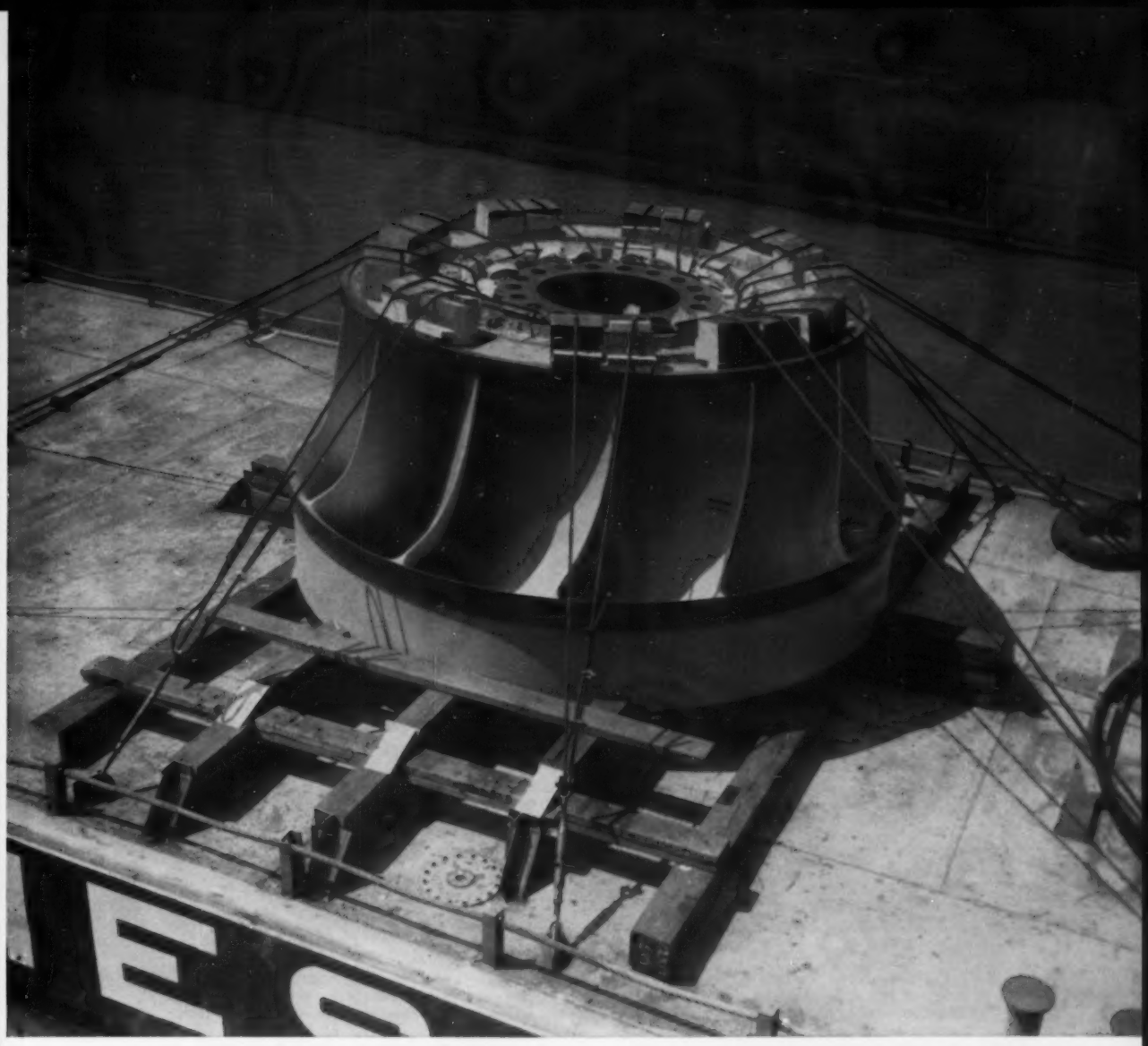
JRK-280

For Better Construction . . . Safer Maintenance

JAMES R. KEARNEY CORPORATION ST. LOUIS MO. GUELPH, ONT.

Specify **KEARNEY PRODUCTS** *The Mark of Quality*

JAMES R. KEARNEY CORPORATION • 4224-42 CLAYTON AVENUE, ST. LOUIS 10, MISSOURI • Canadian Plant: GUELPH, ONTARIO



173,000 lb. "GULLIVER"...largest Francis type runners ever cast in one piece

Baldwin's three hydraulic turbine runners for the Garrison hydroelectric plant are the largest of their kind in the world. 18½ feet in diameter, 9 feet high and 173,000 pounds in weight, they are the largest Francis type runners ever cast in one piece. Maximum horsepower rating is 134,000, limited by a generator loading of 115%.

Because of their size, these runners had to be shipped by inland waterways from Baldwin's Eddystone Division plant near Philadelphia. The photo shows the first runner being readied for shipment to the Corps of Engineers, U.S. Army, flood control and power generating project. It was transported on this barge up the Hudson River to the Erie Canal and across the Great Lakes to Superior, Wisconsin. A special railway car built by Baldwin carried it the rest of the way to Garrison Dam on the Missouri River near Riverdale, North Dakota.

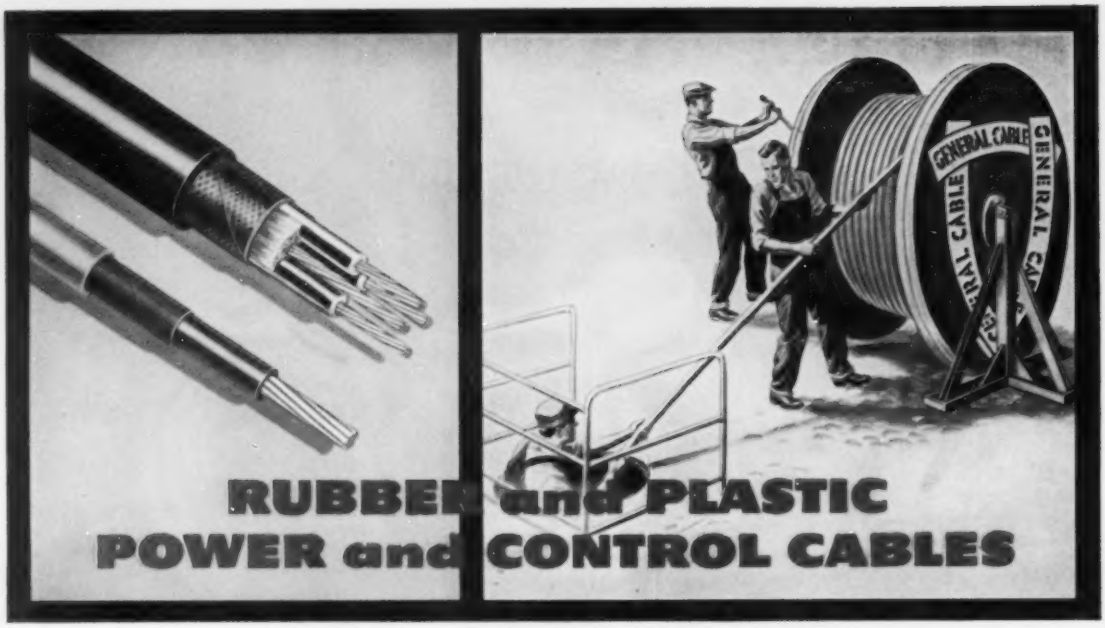
A new bulletin on Baldwin and Pelton hydraulic turbine developments has just been printed. If you'd like a copy, please write to Dept. 5207, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

BALDWIN BLH LIMA-HAMILTON

Eddystone Division

BALDWIN-LIMA-HAMILTON

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE



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When you need Rubber and Plastic Power and Control Cables . . . look to General Cable . . . for every type, for every use . . . for fast deliveries . . . for UNMATCHED QUALITY! These General Cable products have earned an enviable reputation among users for transmission, distribution and control . . . for direct earth burial . . . for duct and conduit . . . for submarine use . . . and for self-supporting aerial applications.

As the biggest producer, General Cable makes the widest range of types. To mention a few: network, high voltage, supervisory and station control, series street lighting, pole and bracket, self-supporting aerial, and generator lead cables.

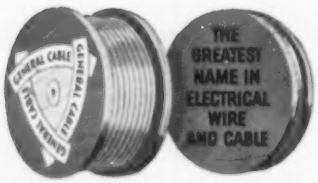
Constructions consist of copper and aluminum conductors. Insulations: GENCASEAL (Thermoplastic Vinyl), polyethylene, THERMAX W (moisture and heat resistant), AQUASEAL (heat and moisture resistant—low SIC), GENCORONE (ozone-resistant oil base), BUTARONE (ozone-resistant butyl base).

Outer coverings include rubber, neoprene, GENCASEAL, lead, reinforced neoprene over lead, and textiles (cotton, glass, asbestos, sisal, jute, rayon).

Armor finishes include steel, bronze, aluminum interlock; flat steel, and galvanized wire armor.

These popular and versatile products are made to meet *every* operating condition. Where standard types are not suitable for your particular use, special constructions will be made to meet your exact needs. Get the complete facts before you buy. Let our engineers help to solve your wire and cable problems. And, remember, that General Cable is the *only* manufacturer who can supply *all* your wire and cable needs!

GENERAL CABLE
CORPORATION



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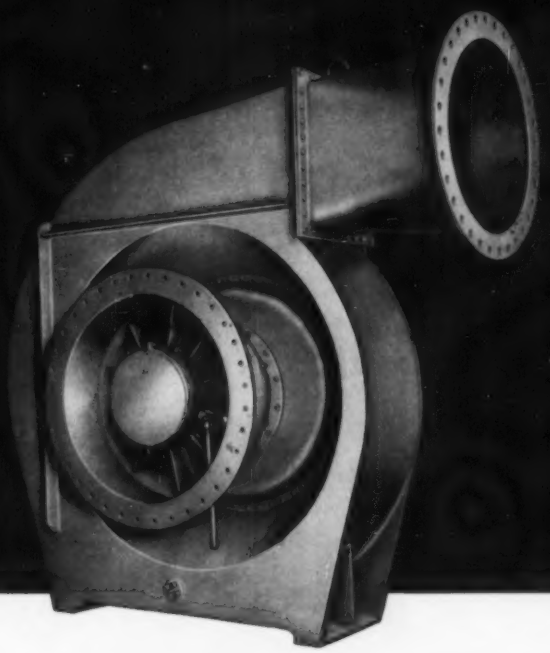
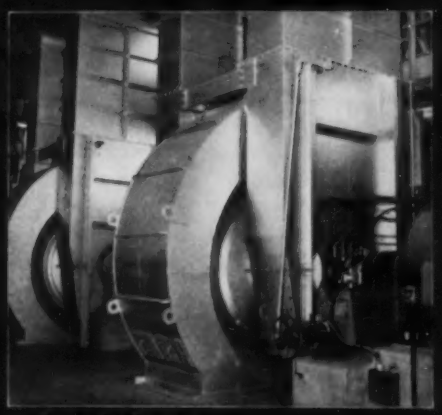
Fact:

Westinghouse 'Design 14' Compressors Engineered to Handle Any Job— 500 to 200,000 cfm at Pressures up to 110" w.g. (4 psi)





Design 14 Compressors operate in parallel with either motor or turbine drive.

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Here is a line of centrifugal compressors for wide application.

In the power field, they provide economical forced draft for pressurized and cyclone furnaces.

Industrial uses include such varied applications as combustion, catalyst conveying, scavenging, flotation, aeration of liquids and many others.

These compressors maintain constant pressure over a wide range of air output—also available with adjustable inlet Spin Control for economical part load operation.

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Casing proportions and streamlined wheel passages make Westinghouse Design 14 Compressors inherently quiet. Accessory sound-absorbing trunks of proved design available to reduce noise level even further where required because of location.

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NAME AND TITLE .....

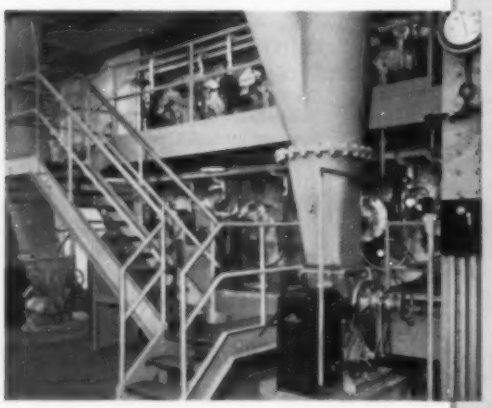
COMPANY .....

CITY ..... STATE .....

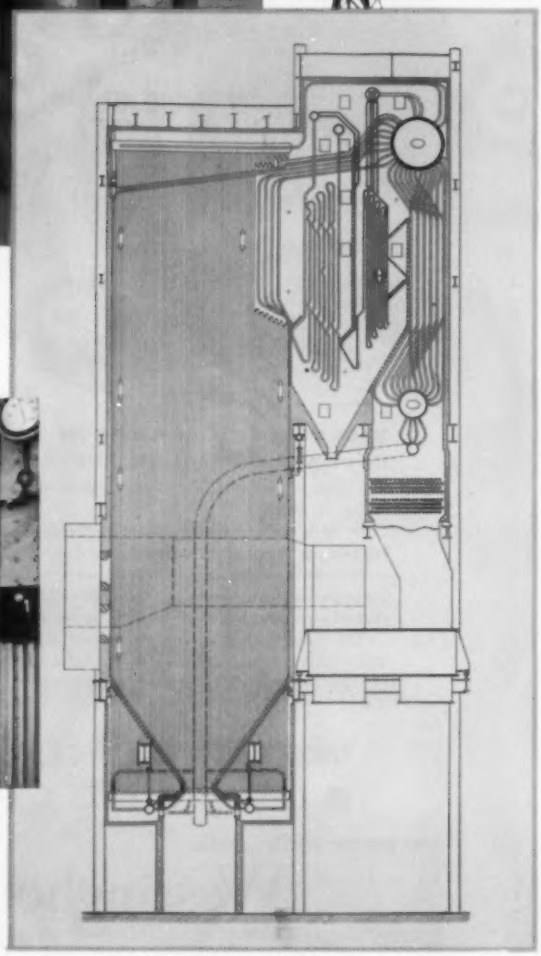
SCHILLER STATION

helps meet rising

Looking east toward Schiller Station and the Piscataqua River. Addition housing FW steam generator now being erected on the right of the present structure. Consulting Engineers: Jackson & Moreland, Boston, Mass.



View showing oil burners serving Foster Wheeler boiler. Fuel consumption 65 gallons of oil per minute.



Cross-section of one of two identical Foster Wheeler 2-drum steam generators at Schiller Station, Portsmouth, N. H. Design pressure 1475 psig; final steam temperature 950F peak capacity 450,000 lbs per hr.

demand for electric service in New Hampshire

Foster Wheeler 450,000 lb per hr steam generator, installed in Schiller Station of Public Service Company of New Hampshire, has augmented station's capability by over 50,000 kilowatts. A second Foster Wheeler unit, now under construction, will contribute an additional 50,000 kilowatts to the rapidly growing power-producing facilities of this business-managed utility.

Reddy Kilowatt

SCHILLER STATION of Public Service Company of New Hampshire was first opened in 1950. But, to meet the ever-growing demand of New Hampshire's thriving industries, farms and homes, in the four short years that have passed, Public Service has found it necessary, upon two occasions, to increase the power-producing facilities of this station.

In the first addition, a two-drum Foster Wheeler steam generator — complete with superheater, economizer and waterwalls as shown in the accompanying cross-section — was installed. This added 50,000 kilowatts to the station's capability. For the second addition, now being constructed, an identical Foster Wheeler steam generator is specified that will contribute an added 50,000 kilowatts.

This installation is another example of Foster Wheeler's ability to design and construct equipment to meet exacting power-producing needs — equipment that reflects the engineering ingenuity of an organization long recognized as a pioneer in the field of steam generation. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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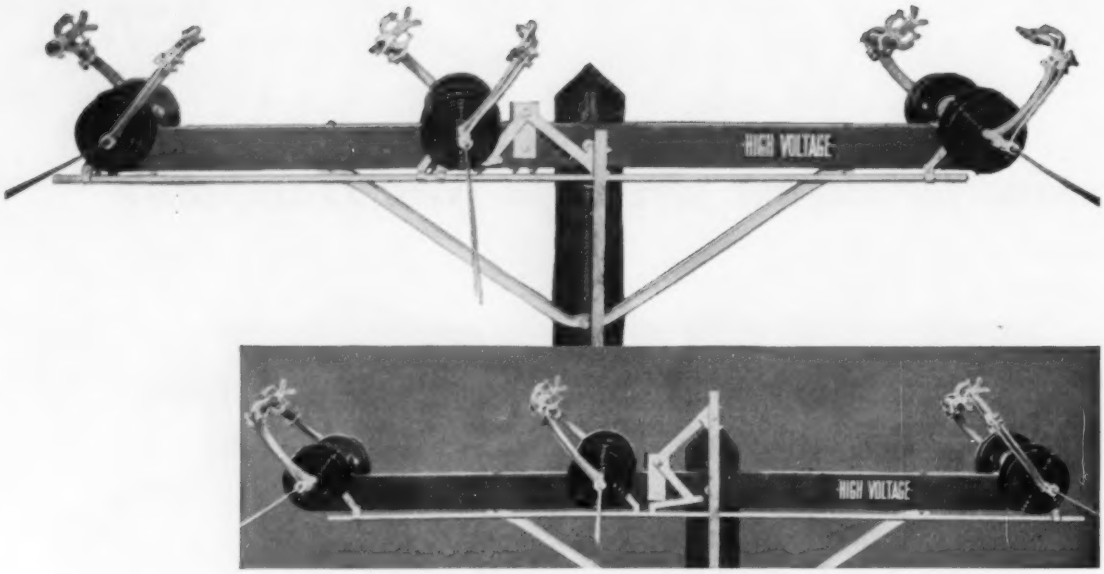
FOSTER WHEELER



Note clean, neat pole top appearance of KPF switches open (top picture) and closed. Appearance is marked contrast with usual clutter of mechanism.

Simple design and sturdy construction insure years of trouble-free switching

KPF Air Break Switches look different because they *are* different. They are the simplest air break switches made. They consist of two rigid dead-end insulator assemblies with rigid jumpers forming the switch arms. One assembly is mounted stationary to the cross-arm. The other rotates to make and break the circuit. There are no complex parts to get out of order, require lubrication, adjustment or other service. Sturdy KPF switches serve indefinitely.

Simple design also means simpler manufacturing and lower cost. No separate dead-ends or extra insulators are required.

Finally, installation normally requires less than half the normal time. Phase units are shipped ready for use and need only be bolted to the cross-arm.

KPF Air Break Switches have been used for almost 50 years on lines ranging from 7.5 to 110 kv. Tens of thousands are in use today by Pacific Gas & Electric, Southern California Edison, Minnesota Power & Light and other leading power companies.

For the world's simplest, surest, lowest cost air break switch, specify KPF Air Break Switches—standard for nearly 50 years.

New catalog gives complete specifications, detail drawings, installation information.

KPF ELECTRIC COMPANY

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...thanks to high-efficiency loudspeaker.
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...operating on any frequency in the 450-470 mc band.

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...Rainbow Tuning—color directed, cutting maintenance hours.

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or TOO GOOD ?

The answer to this question can make an important difference in the performance and cost of your product. If your contacts do not measure up to their intended job, they can seriously detract from the satisfactory operation, freedom from maintenance, and acceptance of the equipment in which they are used. If the contacts are too good, or over-designed, they add uselessly to the cost of the finished equipment.

Designing a contact for a specific job, however, is a real engineering problem. It involves consideration of many electrical, mechanical and environmental factors. The current and voltage in the interrupted circuit . . . the type of load . . . the expected service life . . . contact gap . . . contact pressure . . . ambient temperature and atmosphere . . . these and many other aspects of the problem demand evaluation.

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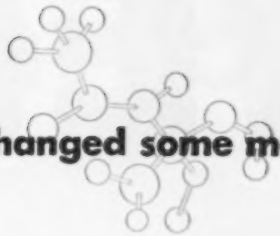
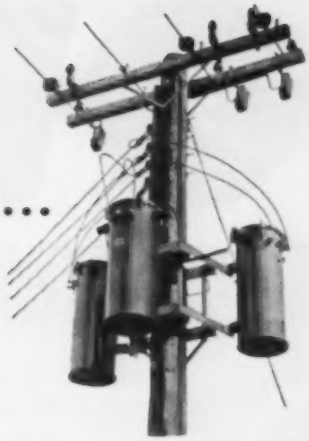


Du Pont changed some molecules...



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Jacketing of "Alathon" has outstanding dielectric strength. This material is lightweight and pliable; linemen find it easy to handle. Jacketing of "Alathon" provides real economy because it lasts for years without festooning or splitting. Another advantage is its low rate of water absorption.

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POWER

DELCO-REMY ThunderVolt A.C. GENERATORS FOR EXTRA-HEAVY ELECTRICAL LOADS

Delco-Remy's new ThunderVolt-12 A.C.-D.C. charging systems are the answer to the *extra-heavy* electrical demands of late-model utility trucks, police prowl cars, and other vehicles equipped with two-way radio, floodlights, or other special electrical units. High wattage output is ample for heaviest electrical loads . . . generators pick up discharged batteries quickly in emergencies. Delco-Remy A.C.-D.C. charging systems are unexcelled at curb-idle . . . furnish up to 180 amperes at higher engine speeds . . . are dependable under the most rugged operating conditions at all engine speeds.

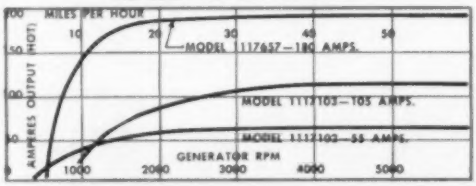
ThunderVolt 6 and 12 application packages, complete with installation instruction sheets for popular makes of cars and trucks, are available. Conversion is simple. See your nearest United Motors distributor for additional information.

A.C. GENERATOR PERFORMANCE DATA

Model	Volts	Cut-In RPM*	Curb Idle Amperes*	Maximum Amperes	Power Watts	Recommended For
1117102	12	600	30-40	55	660	All speeds.
1117103	12	975	6	105	1260	All speeds.
1117657	12	625	100	180	2160	All speeds.
1117062-3-4	6	750	30-40	90	540	All speeds.

*APPROXIMATE (BASED ON 100 GENERATOR RPM/MPH)

A.C. GENERATOR OUTPUT CURVES



DELCO-REMY ThunderVolt D.C. GENERATORS FOR MEDIUM-TO-HEAVY ELECTRICAL LOADS

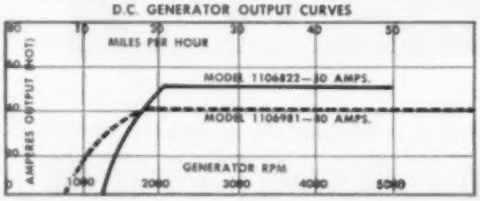
Delco-Remy's ThunderVolt-12 extra-output D.C. generator is an economical answer to the electrical needs of late-model utility trucks, suburban police cars, rural mail cars . . . other vehicles with additional lights, two-way radios, or other special electrical equipment in medium- to heavy-duty service. Delco-Remy extra-output D.C. generators are low in cost, simple to install, economical to maintain. Performance data on typical Delco-Remy ThunderVolt D.C. generators are shown at the right. For further details and application data, see your nearest United Motors distributor.

D.C. GENERATOR PERFORMANCE DATA

Model	Volts	Cut-In RPM*	Curb Idle Amperes*	Maximum Amperes	Power Watts	Recommended For
1106822	12	1300	0	50	600	Medium to high speeds.
1106981	12	800	15	40	480	Low speeds & idling.
1106757	6	830	15	55	330	Medium to high speeds.
1106758	6	600	25	45	270	Medium to high speeds.
1106977	6	600	28	55	330	Low speeds & idling.

*APPROXIMATE (BASED ON 100 GENERATOR RPM/MPH)

D.C. GENERATOR OUTPUT CURVES



Delco-Remy
ThunderVolt
ELECTRICAL SYSTEMS

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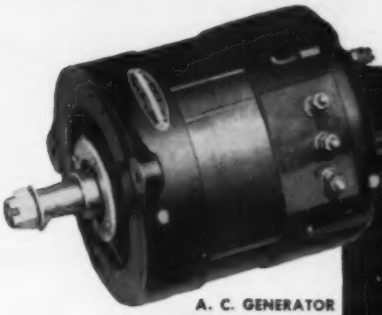
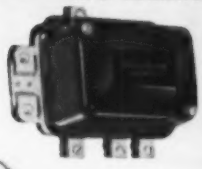
right for the job



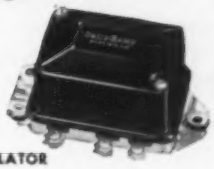
A. C. GENERATOR

REGULATOR



RECTIFIER

D. C. GENERATOR



REGULATOR

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There's a heat pump, de-humidifier, and electronic dust precipitator,
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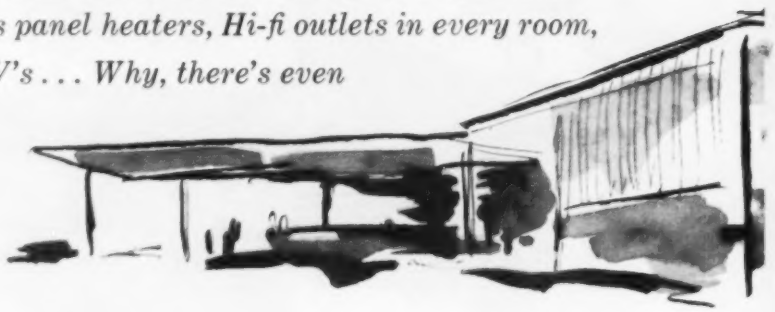
inter-com, four radios, two TV's . . . Why, there's even
an electronic fly killer in . . .



the house the editors of Electrical World built

James M. Hoffman was the architect. Alabama Power Co. worked closely with him and with the owner-contractor to get full, economical cooperation from Man's perfect servant, Electricity. And so did the editors of Electrical World. Here, today, in Anniston, Alabama, is Tomorrow's electric house.

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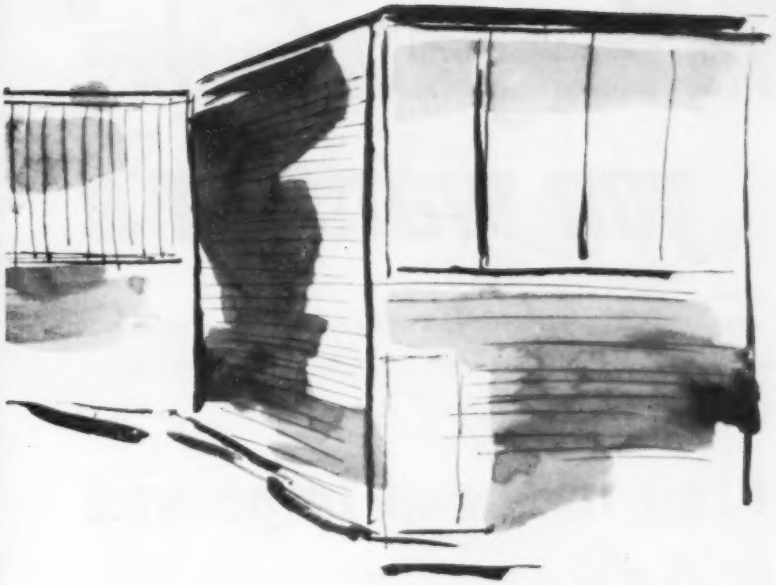
Remember . . . in the dynamic electric power industry,
only World can do the World's* work.*

*Electrical World, that is . . .



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10. Heat pump
11. Precipitron
12. Water heater
13. Exhaust fan
14. Television
15. Amplifier for phone jct. box
16. Automatic sliding door
17. Ceiling heat panel
18. One side of outlets switch – operated
19. Buzzer button
20. Window operator
21. Automatic draperies
22. Cove light
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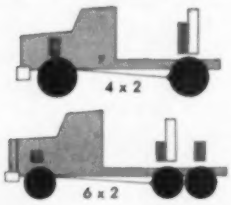
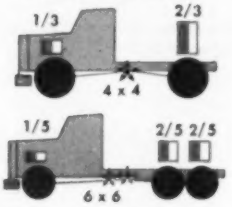


Note how power is wastefully concentrated on one axle.

■ *Proportion of weight on each axle*

FWD WITH ADVANCED MATH-MATIC DESIGN



Note how power is correctly proportioned to weight distribution.

P *Proportion of power on each axle*

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- ★ Greatest operating safety!
- ★ Greater load-carrying capacity!
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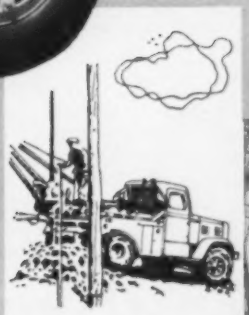

Now—more than ever—more of the weight is working weight in FWDs. New, lighter, tougher steels cut dead weight, increase FWD load-carrying capacity by improving power-weight ratios.

WHAT'S YOUR HEAVY-DUTY TRUCKING PROBLEM?
Along our nation's highways, throughout the world's oil fields, over the rugged terrain utility crews must travel ...anywhere there's tough, heavy work to be done—you'll find FWDs shouldering more than their share of heavy-duty problems. That's what FWDs are for... the tough jobs in tough places, where conventional trucks can't even travel.

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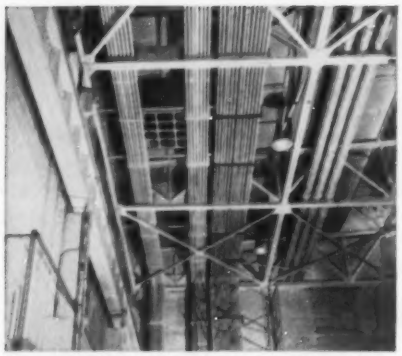
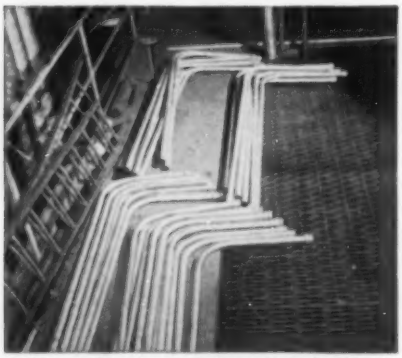


New runs and original runs for control wiring at Moline Generating Station, Iowa-Illinois Gas and Electric Company, are shown in above photograph. Original runs, at left, in Republic Electrunite E.M.T., were made more than twenty years ago. Light weight of Electrunite E.M.T. makes it easier to put up and permits lighter supports. Result: Lower building costs.

Ever since Hector's pop was only a Pup!



Prefabricated bends are made quickly and easily with ELECTRUNITE E.M.T. Note the smooth, wrinkle-free surfaces of these typical 90-degree bends.

More than twenty years and still on the job. That's the record of Republic Electrical Metallic Tubing, the *original* threadless rigid steel raceway, in actual utility service.

And now that Republic E.M.T. has, for all practical purposes, outlasted two Hectors, it can be safely repeated that . . .

REPUBLIC E.M.T. GIVES UNSURPASSED PROTECTION. The protection of steel *plus* unbroken galvanized coating from end to end.

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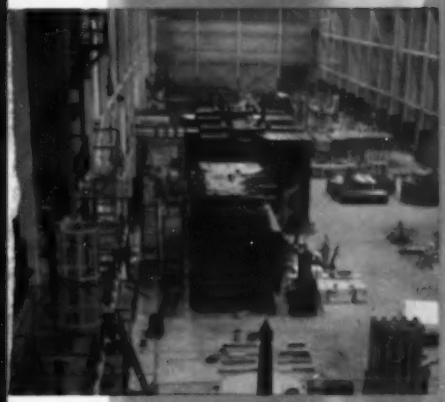
Made by the producers of ELECTRUNITE . . . The Original Electric Welded Boiler Tube



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MOLONEY ELECTRIC CO.

SALES OFFICES IN ALL PRINCIPAL CITIES

FACTORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

Bulletin No. PT2805-1-55

Capacity

FOR ENGINEERING

FOR PRODUCING

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TRANSFORMERS OF UNLIMITED KVA

In keeping with utility trends, these facilities are capable of producing transformers of any Kva rating anticipated.

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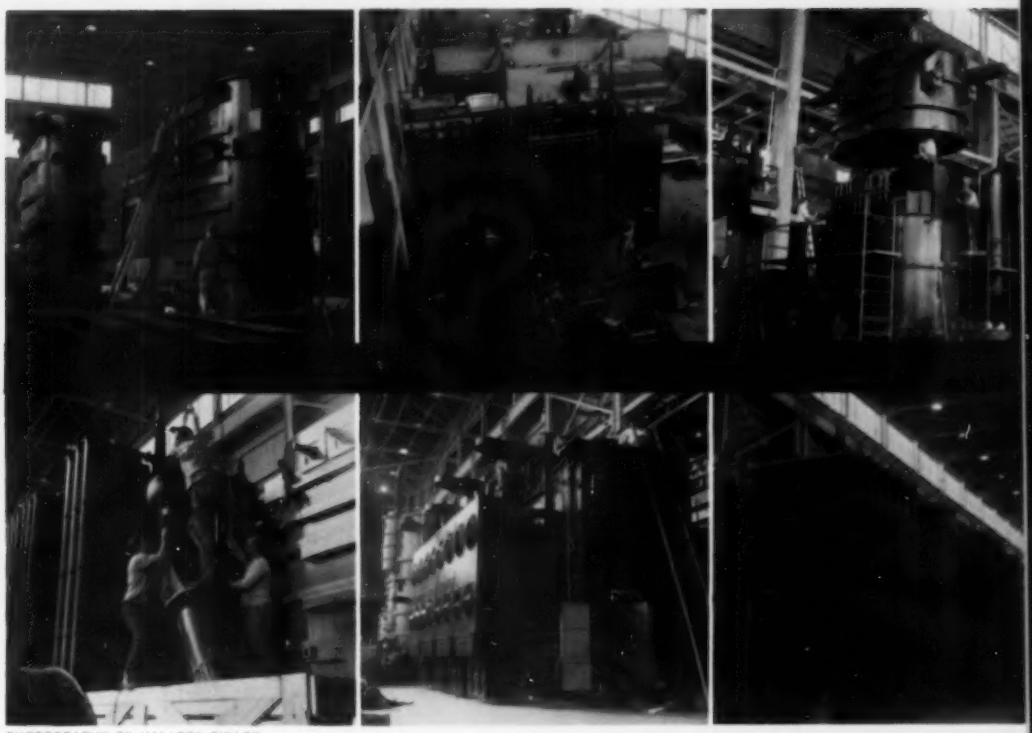
Engineering and Production facilities which are unsurpassed in the industry and backed by 58 years experience in producing fine transformers.



PHOTOGRAPHY BY HALLECK FINLEY

ELECTRIC COMPANY

FACTORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

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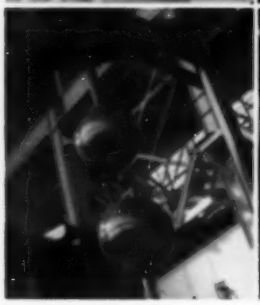
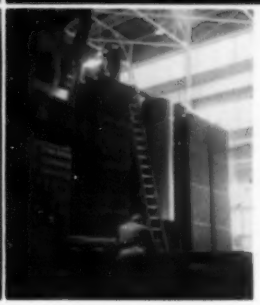
Capacity for testing

The most modern test facilities in the industry are found in the Moloney Plant.





Litho in U.S.A.

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SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

A Saving Worth Seizing

Economic dispatch today holds out very real rewards to power systems that apply its concept to the scheduling of generation and power flow. This concept calls for careful coordination of incremental transmission losses with fuel costs in order to find the lowest-cost sources of power for each system load condition.

Not all systems can apply economic dispatch effectively. On some systems generation and load are so closely linked that transmission losses are not large enough in relation to fuel costs to influence the cost of delivered power very much one way or the other.

However, there are a great many systems in operation where the cost of a trial calculation, to evaluate the effect of incremental transmission losses, can be the price of admission to hitherto unrealized economies. The risk lies in the easy assumption that economic dispatch is only for three or four vast interconnected systems and is beyond the reach of moderate-sized systems. Once it is established that a system's transmission losses are a significant factor in the delivered cost of power, the course to be followed in realizing the benefits of economic dispatch is the same whether the system is large or small. Only the tools differ.

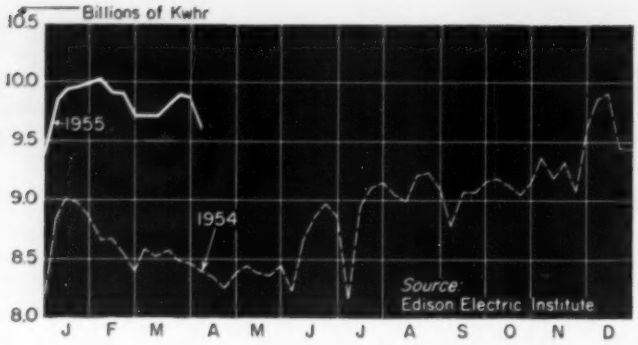
Regardless of system size, the first step in economic loading of facilities is the establishment of a system loss formula into which transmission losses and fuel costs are factored to arrive at an economic loading schedule for particular fuel costs and system conditions.

The second step is a determination of the device to be used to apply the formula. For some systems the information can be read from a set of curves—each for a different set of conditions. For other systems, where major changes in conditions occur frequently, digital computers are required. Some of today's newest computers are capable of regulating plant loads directly.

In this issue is a group of articles on the development and application of tools of this new art. Here Electrical World has also sought to present the case for economic dispatch by the men who have been responsible in large part for its perfection and rapid growth since the end of World War II.

Like most lasting developments it has risen on its economic merits because it offers today's modern power systems not only a tool to achieve important savings in the cost of power system operation, but also because it is still another link in the lengthening chain of industry achievements that have contributed to delivering electric power from the generator to the customer at lower and lower costs.

THE ELECTRICAL WEEK



OUTPUT

Week Ended Apr. 9
9,633,000,000 Kwhr
Up 14.7%

Per Cent Change from Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
Apr. 9	+14.7	+5.6	+6.1	+17.4	+4.4	+25.0	+6.2	+14.2	+8.8	+20.5
Apr. 2	+15.8	+7.4	+9.2	+17.3	+4.3	+26.9	+8.1	+15.0	+11.5	+16.5
Mar. 26	+16.7	+11.7	+9.8	+18.4	+8.3	+25.3	+9.0	+17.7	+14.4	+16.4

Seasonally Adjusted Index 188.6 Week Ago 190.1 Year Ago 164.6

The Issue's News Highlights . . . First congressional field hearings on Hells Canyon legislation serve as a skirmish for 1956's Northwest political maneuvers . . . AEC gets four atomic power plans from three private groups and one public district to build units to produce 455,000 kw . . . Manufacturers' have busiest quarter as heavy equipment sales make history . . . Regulations for licensing private industry to build and operate atomic power plants are proposed by AEC.

Rate Changes: District of Columbia PUC has approved $3.8 million annual rate increase for Potomac Electric Power. PUC also has vacated the "Modified Sliding Scale Plan" for rate making . . . In review ordered by state Supreme Court, Pennsylvania PUC has rejected $4.7 million annual rate increase sought by Duquesne Light since 1952. PUC also tied to its new order a reduction of $375,000 a year in Duquesne's industrial rates . . . Missouri PSC has approved $3.5 million a year rate increase for Kansas City P&L effective April 20 . . . Colorado PUC has granted Home Light & Power $126,419 a year rate increase to yield 6.32% return.

Westinghouse has received $1,464,520 contract from Army Corps of Engineers to supply two 50,000-kw main generators at Table Rock Dam in Missouri. Meanwhile, European firms have underbid U. S. companies for three 103,300-kva transformers for Chief Joseph Dam on Columbia River, Washington. English Electric was lowest at $470,965, while lowest domestic bidder was Pennsylvania Transformer with $556,868. But Pennsylvanians in Congress are forcing decision on contract to steps of White House. Woodward Governor was low bidder at $235,976 on contract to furnish six 100,000-hp hydraulic turbine governors for same project.

Future TVA power expansion could be done through a region-wide, non-profit corporation, or by one or more of its municipalities, according to David E. Lilienthal, former TVA chairman. "Personally, I happen to think this is the best course, for the long pull, and the sooner the better. You are paying for these plants; you ought to own them," he said in address to Athens College, Ala., last week. The "Dixon-Yates device is not an alternative way of providing power for the Valley," said Lilienthal.

Square D Co and UE-Ind start negotiations this week under wage-reopening clause in contract. Union carried out violent 107-day strike over last year's negotiations, but observers see no likelihood of strike this year. In another action, NLRB has ordered UE to show why it should not lose its rights before board because union officer had not filed non-Communist affidavit.

NEWS OF THE INDUSTRY BRIEFLY TOLD

Off the Washington Wire . . . White House has announced resignation of SEC Chairman Ralph Demmler. President will name J. Sinclair Armstrong new chairman. Armstrong, a Chicago attorney, has been with SEC since 1953. Andrew D. Orrick, regional SEC administrator in San Francisco, will be nominated to SEC membership . . . Hoover Commission has recommended abolition of FPC and other regulatory agencies. It says their functions should be incorporated in new federal court to handle certain tax, labor, and trade disputes . . . Public and private utilities went to Congress last week to protest high costs of system relocations involved in President's $37-billion highway program . . . Pacific G&E told Congress last week its Trinity River partnership proposal could save government capital outlay of $50 million if company built power phase of Central Valley Project.

Palmetto Electric Co-op is considering selling out to South Carolina E&G . . . Niagara Mohawk Power has placed in operation new 22,500-kw hydro station at Five Falls on Raquette River, bringing system's total generating capacity to 3,150,000 kw . . . William A. Roberts, 57, president, Allis-Chalmers Manufacturing, died in Milwaukee, April 12 . . . A 270,000-lb, 56,000 kva, oil-immersed current-limiting reactor, largest ever built by General Electric, has been shipped to Electric Energy's Joppa plant.

Atomic Power: New England Power Co, participating utility in Yankee Atomic Electric, has acquired site for group's proposed nuclear power plant in Deerfield River valley at Rowe, northwestern Massachusetts . . . Labor Secretary James P. Mitchell has appointed study committee to advise him on labor-management problems in atomic energy . . . Dr Lawrence R. Hafstad, formerly of AEC and now with Chase Manhattan Bank, says Britain has taken over world leadership in atomic power development with its major reactor program. He admits fuel costs favor nuclear power application in Britain but says U. S. will continue to lag unless it subsidizes private companies.

Waterville, Ohio, Village Council has voted to consider new offer by Toledo Edison to buy village's municipal power system for at least $200,000 . . . John H. Hunter, commissioner in charge of Springfield, Ill., city water, light and power properties, was defeated in bid for re-election . . . Libby Dam studies have been shelved by International Joint Commission until Canada decides what to do with Kootenay River waters in British Columbia.

ABOUT PEOPLE IN THE INDUSTRY

Interstate Power, from being a "down and almost out" midwest electric and gas utility, got back on its feet to become a first class operating company with annual operating revenues of over $18 million, Pres M. L. Kapp told New York Security Analysts. Company "expects to earn fair return on all retained earnings, and from time to time will increase common stock dividends as earnings justify," he added. Earnings this year are estimated at 97¢ a common share, and company will spend $44 million for expansion in 1955-61.

Harry B. Munsell, president, Kansas City P&L, who has taken lead in forming Southwest Electric Conference (EW, April 11, p 6), told charter meeting: "Last summer's heat wave in this ten-state (southwest) section presented new and demanding problems requiring immediate action in strengthening and extending our distribution systems. To many companies, the imbalance developing as between summer-time and winter-time peaks has made it necessary for us to take a new—and longer—look at selective load building."

More News About People page 168

Hells Canyon

• Northwest reverberates with fury of dam debate when Senate unit holds four hearings

• Dam looms as '56 issue as Senator Morse, GOP governors engage in political pot shots

Governor Smylie Is Against High Dam . . .

. . . Idaho Farmers Split Down Middle, but . . .

. . . Democrat Brunt Supports the High Dam

The first congressional field hearings on Hells Canyon legislation produced three days of highly conflicting "grass-roots" testimony along the tortuous course of the Snake River that left one dead and the highly controversial canyon reverberating with the fury of high dam versus low dam debate.

The Senate Interior Committee conducted four hearings in three days in a fast-moving schedule that included a flight through Hells Canyon over the proposed federal dam site. Some 130 witnesses actually took the stand to testify during the 20 hours of hearings, while hundreds who were unable to be heard were permitted to file statements for the record.

Some frustrated would-be witnesses trailed the committee from Boise, Idaho, in a vain effort to present testimony as to whether there should be a high federal dam or three low-head private power dams along the middle reaches of the Snake River.

Of the witnesses fortunate enough to be heard, the breakdown between proponents and opponents of the high dam legislation is as follows: Boise—12 for and 10 against; Lewiston, Idaho—16 for and 14 against; Pasco, Wash.—20 for and 19 against; and Portland—21 for and 18 against. Time was equally divided.

A less fortunate witness was Winford Thomson, 60-year-old farmer of Otis, Ore., who suffered a heart attack a few minutes after testifying as an opponent that "free enterprise was on trial." He was pronounced dead on arrival at a Portland hospital.

Politics dominated the Portland

PICTURES: Gov Smylie (shown at top) testified at Boise, Idaho, hearing. Listening to testimony were (l to r) Rep Sisk, Rep Gracie Pfost, Sen Watkins, Sen Murray, Special Committee Consultant Goodrich Lineweaver, Sen Dworshak, Sen Welker, Sen Barrett, and Sen Morse. Past State Democratic Chairman Bill Brunt of Idaho Falls (shown at bottom) also testified at congressional group's meeting at Boise.

Grass Roots Hearings Stir Political Tempest

hearings, which Sen Henry Dworshak, Republican of Idaho, charged were used to launch the 1956 senatorial campaign of Sen Wayne Morse, Democrat of Oregon. Morse introduced S 1333, the legislation calling for federal construction which provided the basis for the hearings. Not a member of the Interior Committee, Morse attended the hearings as an observer, as did four members of the House Interior Committee.

The Portland hearings were opened with appearances by Gov Arthur B. Langlie of Washington and Gov Paul Patterson of Oregon, both strongly opposing the Morse legislation, cosponsored by 29 other senators. Following Patterson's appearance, Morse got the floor to speak as a "proponent" and gave an impassioned defense of his bill.

"This dam belongs to the people," he asserted, "and must not be given away to monopolistic combines." Morse gave a rebuttal to the arguments of the governors, stating that "in listening to two governors I hear arguments of the Idaho Power Co that I have heard many times."

Morse concluded by predicting that the Hells Canyon battle will be "fought out at the crossroads of Oregon" during the 1956 campaign.

It is generally believed that Governor Patterson will oppose Morse next year in his first try to hold his seat as a Democrat.

Senator Dworshak asserted that Morse's "crossroads" prediction indicates that congressional approval of Hells Canyon is not expected at this session of Congress. "They'd rather keep Hells Canyon as a political symbol," said Dworshak, "than to pass the legislation."

The Idaho Senator stated that he may soon introduce a bill to authorize construction by the Army Corps of Engineers of a dam at Bruces Eddy on the North Fork of the Clearwater River (a Snake tributary) where he said "flood water was most menacing in the devasting floods of 1948." He said a dam at Bruces Eddy would produce almost as much power as Hells Canyon Dam at one-third the cost and would not divert one acre foot of irrigation water.

"I think it is obvious," said Senator Dworshak "that the main purpose of the hearings was to provide a platform from which Senator Morse could launch his campaign for re-election. Certainly the information and light that has been shed on this controversial issue during these quickie hearings have been negligible. I maintain the chief beneficiary of the hearings was Senator Morse."

Earlier it had been announced that the purpose of the hearings was to tap grass-roots sentiment along the course of the Snake River area to be affected by the pending legislation.

It was pointed out that over a year had been devoted to technical testimony in hearings last year before the Federal Power Commission on a pending application of Idaho Power to build three low-head dams in the same area for less money, but which would not generate as much power.

In Portland the first witness was

NW Citizens Await Turn to Testify before . . .

. . . Senate Committee Hearing in Pasco, Wash.

LANGLIE: High dam 'a phony'

Gov Langlie, whom many expect to run against Sen Warren Magnuson in 1956 for the Senate. Langlie attacked the Hells Canyon project as "a phony when viewed from standpoint of logical power development."

Langlie said that the "building of a high head storage project in Hells Canyon is unwise and the money that would be spent on this project would be a monument to governmental error."

Gov Paul Patterson of Oregon urged Congress to hold up on Hells Canyon until the issues could be threshed out and in the meanwhile to push through funds for the John Day project on the Columbia, which has been authorized but for which no funds have been appropriated.

Governor Patterson said that John Day would cost $320 million against $473 million for Hells Canyon and contrasted the ultimate generating capacity of John Day at 1,530,000 kw with the 900,000 kw ultimate installed generation capacity for Hells Canyon.

At Pasco, former U. S. Sen Clarence Dill, Democrat of Washington, compared the Hells Canyon struggle with efforts to get authorization for Grand Coulee in the early thirties. Dill said that the same arguments in behalf of the three low dams—that they could be built more quickly and cheaply—were advanced in behalf of the privately proposed Kettle Falls Project that would have flooded the Grand Coulee site.

Sen Henry Copeland of Walla Walla, GOP state senator, challenged Dill on the grounds that the two projects could not be fairly compared since Grand Coulee was a full blown multipurpose project, while Hells Canyon would produce chiefly power.

Proponents at Pasco also pointed out that four dams on the lower reaches of the Snake (authorized in 1945)—Ice Harbor, Little Goose, Lower Monumental, and Lower Granite—would be feasible only if Hells Canyon high dam were erected above them so as to firm up their power potential. No funds have yet been appropriated to get these projects started.

Hearings at Boise were clearly labeled "political" (EW, April 11, p 10, 64). On the whole, it was found that conservative, Republican elements were lined up against the high dam proposal and Democrats and labor for, with the farmers split down the middle.

The Boise hearings showed a preponderance of sentiment against the federal project, while at the Lewiston, Idaho, meeting sentiment swung in the direction of the high dam proponents.

Pressure Groups

One disappointment of the hearings was the domination of the hearings by pressure groups on both sides. At least three-fourths of the witnesses appeared to have been influenced in their testimony by the organized pressure groups that followed the hearings from start to finish. Chamber of Commerce, public officials, businessmen, and some farmers leaned toward private development, while labor, organized public power groups, farm co-operatives, farmers' unions, Rural Electrification Administration groups, and public utility district officials overshadowed testimony at all hearings.

Sen James E. Murray, chairman of Senate Interior Committee, presided at hearings in Boise and Lewiston (EW, April 11, p 10, 64), while Senator Neuberger presided at Pasco and Portland. Other committee members attending all or part of hearings: Senator Dworshak of Idaho, Sen Frank Barrett, Republican of Wyoming, and Sen Arthur Watkins, Republican of Utah. Senators who sat in as guests of the committee were Senator Morse and Sen Herman Welker of Idaho. House members who attended as observers: Rep Gracie Pfost, Democrat of Idaho, Rep Edith Green of Oregon, Rep Lee Metcalf of Montana, all of whom introduced high dam bills, and Rep B. F. Sisk, Democrat of California, of House Interior Committee.

4 A-Power Plans

AEC gets proposals from three private groups, one public district to build reactors

Four utility groups have applied for government aid under the Atomic Energy Commission's power demonstration reactor program. Together, they plan to spend from $120 million to $135 million on 455,000 kw of capacity in four different types.

The proposals were submitted as AEC closed out its demonstration reactor program April 1.

Electrical World described two of the reactor proposals last week (EW, April 11, p 8). These were:

- A $45-million, 100,000-kw fast breeder to be completed by 1958 by Atomic Power Development Associates.
- A $20 million to $25 million, 100,000-kw pressurized water converter reactor to be completed in late 1957 by Yankee Atomic Electric Co.

At that time, AEC had not announced all applications; it was allowing time for late arrivals to come in under the deadline.

Two did:

- The Nuclear Power Group asked to be able to build a 180,000-kw boiling water plant, for completion in 1960.
- The Consumers Public Power District of Columbus, Neb., proposed a 75,000-kw sodium graphite reactor for completion in 1959.

Estimates of costs for all four proposals run to $150 million, of which the applicants would put up 80 to 90%. This means AEC is being asked for $15 to $30 million in aid out of the $75 million it asked Congress for.

Cost is only one factor in AEC's evaluation of the proposals. Each reactor proposal is being weighed on the basis of its cost to AEC in funds and materials, the risk to be assumed by the proposer, the competence and responsibility of the proposer, assurance against abandonment of the project, and above all the probable contribution of each project toward economically competitive power.

In the proposals submitted by the four groups, there was mention made of the federal government assuming some of the public liability and property damage coverage in connection with the commission's demonstration reactor program.

Manufacturers' Busiest Quarter

Heavy equipment sales during first quarter made history. In all, electric utilities placed orders for:

- **101 turbogenerator units**
- **With capacity of 8.4 million kw**
- **At approximate cost of $255 million**

Of these,

- **61 units were above 50,000 kw for 7.7 million kw**
- **40 were 50,000 kw and below for .7 million kw**

Heavy equipment manufacturers and electric utilities are closing their books on the biggest order-placing, order-taking spree in history. The figures above indicate the magnitude of sales volume on turbogenerator units during the period January through March.

Orders placed for steam generating capacity during those three months exceed the new capacity installed by all utilities during any single year with the exception of 1953 and 1954. Delivery dates for the orders placed during the period range from late 1956 through 1958.

Further information developed by an Electrical World sample survey indicates that utilities placed orders for more than 800,000 kw of turbogenerator capacity in December of last year—bringing the four months' orders to around 9.2 million kw. This exceeds the new steam generating capacity placed in service by electric companies during 1954.

Orders for turbogenerators were accompanied by orders for their unit transformers and associated high voltage switchgear at the plant. While in a few cases auxiliaries and low-voltage switchgear were included, this was not the rule.

Market Steadies . . . The huge order volume was sparked by price cuts on many items of heavy equipment (EW, Feb. 28, p 18). By this month most of the scurry had gone from the cautious spree which had occurred mainly during December, January, and early February. During all of March, prices on heavy items were in the process of firming up. By early this month turbogenerator units were around 5% off list. Orders were still being placed, but at a more leisurely pace than in the previous months.

Units Ordered In First Quarter

Name plate	Number of Units
200 Mw and above	7
150-200 Mw	18
100-150 Mw	24
50-100 Mw	12
0-50 Mw	40

Many utilities that had firm plans for capacity additions took advantage of the attractive offers to do their buying. Publicly and privately owned utilities as well as industrial firms participated. Every section of the country is represented in the huge volume of orders placed during the relatively short period. In a few cases tentative orders were placed, but the rapid increase in energy sales would indicate that most of these will be firmed up rather than cancelled.

Of significance are the sizes of the turbogenerator units ordered (see table). Seven of these were in the 200,000 kw and above class. Of these, three were 250,000 kw units. No unit of that size is in actual operation at present, although at least two other larger turbogenerator units are being manufactured.

As far as can be determined, the market for smaller equipment from distribution transformers down has remained fairly stable during the period. Industry sources say prices have been maintained on these items. Same is probably true for many steam station auxiliaries and it appears likely the demand for these will rise in order to complete purchases for planned capacity additions.

Southwest Electric Conference Organized

H. B. Munsell, president of Kansas City Power & Light Co, has taken the lead in forming the Southwest Electric Conference, which held its initial meeting in Chandler, Ariz., April 4-5. The group includes utilities in Arizona, Arkansas, Iowa, Kansas, Louisiana, Mississippi, Missouri, New Mexico, Oklahoma, and Texas. Others active in its formation were Dudley Sanford, Union Electric Co of Missouri; J. B. Thomas, Texas Electric Service Co; Donald S. Kennedy, Oklahoma Gas & Electric Co; Murray F. Gill, Kansas Gas & Electric Co; and H. B. Sargent, Arizona Public Service Co.

New group will start out with one meeting per year. There will be no formal organization, no dues, and no secretary. The group will have a governing body made up of one representative from utilities in each of the ten states. Attendance will be limited to top officers of the participating companies.

Program for recent meeting included well-balanced subject matter.

G. A. Price, president, Westinghouse Electric Corp, outlined the challenges for the industry in terms of growth potential calling for bigger turbogenerators; higher transmission voltages; new technology for systems operation; and a radical overhaul of distribution techniques.

J. W. McAfee, president, Union Electric Co of Missouri, said that if the industry did not step into the nuclear power field, we would see the government move in and eventually socialize the industry and the whole economy. He emphasized the need for convincing the public that some expenditures must be made today in order to assure improvements in atomic energy for the future. In reviewing results of Electric Energy Inc, he pointed out that the first year's cost was 3.77 mills per kwhr. He also reported that due to more favorable state taxes, better heat rate and lower manpower requirements than expected, the cost of power at Joppa will be about the same as original estimates in spite of the higher capital cost.

Harold Quinton, president of EEI and Southern California Edison Co, urged utilities to bring younger men, in early forties, into top management.

AEC Outlines License Rules

Commission makes public its proposed regulations for licensing utilities to construct and operate reactors

Electric utilities can now obtain licenses to own and operate atomic power plants.

Atomic Energy Commission Chairman Lewis Strauss announced new regulations to make this possible last week. Although they're not complete, they set forth all the information private companies need to prepare their license applications and to get started in the nuclear power business.

The new rules provide for:

- Licenses to own and use nuclear reactors and fuel.
- Security and safeguards for restricted data.

Still to come are revisions of existing regulations governing source and byproduct materials, and new rules on reactor operators' licenses, health and safety, and administrative procedures.

Strauss said the regulations are aimed at minimizing government control over competitive enterprise. He said they impose on a licensee "only those controls which we believe are clearly needed to protect the health and safety of the public and the national security."

The regulations make it clear for the first time that AEC intends to license all types of reactors, gaseous diffusion and other isotope separation plants, and chemical processing and fuel element fabrication plants.

The regulations aren't official yet. They're just being published in the Federal Register, the official government publication.

When publication has been accomplished, any interested person may submit recommendations to AEC within 30 days before they are officially promulgated as binding rules.

Two types of licenses are provided in the first regulation:

- Class 104—Named after that section of the 1954 law pertaining to research and development and medical therapy. The agency has in the last few weeks received applications for four large nuclear power plants designed to demonstrate atomic power potential, and one for a plant to be operated as a going enterprise in an existing system. Since none of these has been proved out as commercially feasible, they'll probably all receive Class 104 licenses.
- Class 103—Named after that section of the law pertaining to facilities determined by AEC to be of practical value for industrial and commercial purposes. AEC has not yet made any such determinations, but when some of the above-mentioned plants get farther along, and show commercial promise, their Class 104 licenses may be converted to 103's.

The commission will notify all regulatory agencies having jurisdiction over rates and services of applicants, and to others concerned with their activities. It will lean on a new type preference clause, giving preferred treatment to applications from public bodies and co-operatives in high-cost power areas, second place to others in such areas, third place to public bodies and co-ops in other areas, and last place to others in non high-cost areas.

Components Not Licensed

AEC has decided not to require licensing of reactor components, at least not yet. It may in some cases change its mind and require a license for an important component designed especially for a production or utilization facility—which require a license—but as a general rule it won't.

License will run for the useful life of the facility, up to 40 years. Renewal is provided. Applications should be sent, in triplicate, to the Division of Licensing, Atomic Energy Commission, 1901 Constitution Ave., NW, Washington 25, D. C., and must be signed under oath. Each must contain:

- Full name, address, age, citizenship of individual. For corporations, state of incorporation, location of principal office, names, addresses, citizenship of principal officers, control or ownership by any alien or foreign entity.
- Class of license applied for, applicant's technical and financial qualifications, use to which facility will be put, period of time sought, list of other licenses issued or applied for in connection with the facility.
- Earliest and latest dates for completion.
- For Class 103 licenses—list of names and addresses of regulatory agencies having jurisdiction over rates and services of the activity, and of municipalities, private utilities, public bodies and co-ops within transmission distance and authorized to distribute within the area to be served.
- Descriptions of chemical, physical metallurgical, or nuclear processes to be performed, description of the faculty, description of the site, description of proposed procedures for routine and nonroutine operations, start-up and shutdown, maintenance, employe training, description of plans in event of accidents, complete meteorological, hydrological, geological, and seismological data. For such technical data provision is made for extension of time if not immediately available.
- Restricted data must be separated from unclassified information.
- All applications will be available for public inspection.

For licenses to obtain and use special nuclear material (fuel), filing requirements are similar. In addition, however, AEC must know when the first shipment will be needed and a rough timetable for subsequent shipments, estimates of losses and production of fuel. If applications strain AEC's supply, the agency will supply first those it believes will further development of commercial atomic energy. Subcontractors or suppliers must be furnished fuel out of a licensee's allocation.

Fuel lost or burned up must be accounted for and paid for. Inspection and testing will be required.

To obtain restricted data necessary to carry out his activities, an applicant must describe completely his procedures for safeguarding the information. These must comply with the standards set forth. All in all, these are quite liberal.

They require for "secret" data locked vaults, safes or safe-type steel files secured by steel lock bars and three-position dial-type changeable combination padlocks in places periodically patrolled by protective personnel or under automatic alarm.

"Confidential" material can be stored in steel file cabinets equipped with steel lock bars and dial padlocks, without the requirement for guards.

Top secret data must be safeguarded according to instructions from AEC.

A. S. GRISWOLD . . J. F. FAIRMAN . . Wm. WEBSTER . . SEN. HICKENLOOPER . .
Detroit Edison Con. Edison New Eng. Elec. Com. on Atomic Energy

T. G. LeCLAIR . . . PHILIP SPORN . .
Commonwealth Edison American G&E

Speakers at the American Power Conference . . .

Reveal Nuclear Power Proposals

- **Supersized and supercritical fuel-fired boilers**
- **Gas turbine aids nuclear and conventional cycles**
- **Distribution for growing residential demands**

Two utility proposals to build nuclear power plants, and rumors of more to come, dominated several major sessions of the American Power Conference at Chicago March 30-April 1.

New England Electric Vice President William Webster told of Yankee Atomic Electric Co's proposal to build a 100-Mw plant in the Berkshire Hills of northwestern Massachusetts. This project, he said, is backed by utilities supplying 90% of New England's power. Their aim is prompt construction of a plant designed from current engineering knowledge for dependable operation. This dictates selection of a thermal converter using metallic fuel moderated and cooled by pressurized water. Conventional financing will raise the $20 to $25-million investment, and its advocates are confident that operating cost will prove acceptable.

Consolidated Edison's proposal filed only a few days earlier embodies somewhat different concepts. This plant, said Vice President J. Fairman, will burn thorium and uranium in a pressurized-water convertor. Steam thus generated at 420 psi 450 F will be boosted to 1,000 F in an oil-fired superheater to add 96 Mw at 7,700 Btu per kwhr. Overall heat rate for 236 Mw is predicted at 10,700 Btu per kwhr and total production cost, 9 mils per kwhr. Investment is expected to run $230 per net kw. Large conventional steam plants costing $200 per kw can produce at 7.5 to 8.0 mills, he added.

Propose Other Reactors . . . Nuclear Power Group would propose a boiling water reactor, implied Philip Sporn, president of American G&E. Such a project could not yet compete successfully with fossil fuels and might need some public funds. But this is expected to give thermal and cost advantages and overcome to some degree pressure and temperature limitations of other contemporary designs. Cost per kwhr might run about 10 mills, compared with 6.5 to 7.0 mills for conventional fuels in the Chicago area.

The breeder reactor provides the most practical approach to commercial nuclear power, reported A. S. Griswold, assistant to the president, Detroit Edison. Its research affiliate, Atomic Power Development Associates, Inc, has designed such a plant for 100-Mw capability. But steam at 600 psi 750 F reduces its performance below original expectations.

Future Offers More Types . . . Dr Chauncey Starr of North American Aviation described experimental work on the sodium graphite reactor. A 20 thermal Mw pilot unit is to be operating in 1956. Starr visualized improvements and new fuel elements which would produce 75-Mw and then 175-Mw power plants. Efficiencies would reach 30 and 33.5%, respectively, with only minor changes in the initial 20-Mw design. He predicted developments that would build reactors to 300-Mw capacity for $208 per kw.

John W. Landis, Babcock & Wilcox Co, discussed reactor types worthy of consideration by utilities studying the potentialities of nuclear power. The basic types were (1) pressurized water, (2) boiling water, (3) liquid-metal fuel, (4) aqueous homogenous. Ten variations of these already deserve study, and others will be developed within five years.

Reactor Fuel Cost Is Problem . . . Discussion revealed extensive concern about the terms under which utilities might procure atomic fuel. Forum moderator, B. B. Hickenlooper, U. S. Senator and member, Joint Committee on Atomic Energy, noted that the new act promotes civilian participation. Military security, he said, is the only reason for government monopoly in atomic fuels. He intimated that AEC would collect a fee for the initial charge plus a variable periodic amount for use.

Atomic power will take the same

(*Continued on page* 104)

SPECIAL PRIVILEGE is not sought by private utilities, A. M. Beebee, Rochester G&E president, tells All Engineers dinner session. Chairman Fischer Black listens

APC Reveals Nuclear Plans

(*Continued from page* 103)

kind of pioneering as was required for the steam turbine, said John W. Evers, Commonwealth Edison president. Today the problems are made more acute by the shortage of trained engineers. The electrical industry has a challenge, which it must meet with money, men, megawatts and imagination, Evers declared.

Predict Atomic Power Growth . . . S. Untermyer and A. G. Mellor, General Electric, described a dual-cycle nuclear power plant which they said could almost compete with conventional plants now if operated at 100% load factor. Estimated investment cost is $200 to $270 per kw, and fuel costs, 1½ to 2 mills per kwhr. They predicted that, of the new power capacity to be placed in service, nuclear plants would account for 2% from 1960 to 1965; 14% in 1970; and 65% in 1980.

W. Kenneth Davis, AEC Division of Reactor Development, agreed with these predictions on the probable growth of nuclear power production. Davis predicted that once nuclear reactors found their place there would be a snowballing effect that would bring more and more of them into the picture. The industry must take the initiative in getting nuclear power costs down. Under "cost-plus" contracts, he said, we will never have the incentive to make costs competitive.

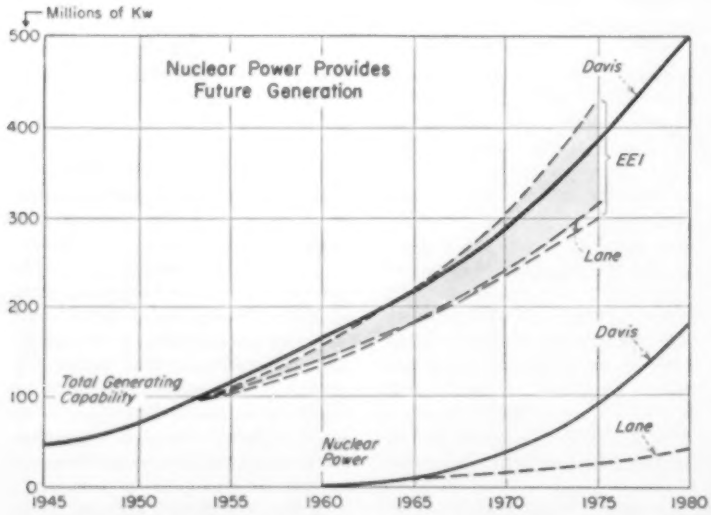
Private utilities do not seek special privilege, said A. M. Beebee, president, Rochester G&E, but only "equality of opportunity and equality of taxation." Either the whole power industry should be relieved of taxes, or all should pay their fair share. Beebee branded "preference" as "not only unfair but primarily for political purposes." This, he said, benefits a few by discrimination against many and can only lead to socialized power.

Steam Research Continues . . . Even though atomic energy replaces fossil fuels, steam turbines will remain the prime mover for upwards of 80-million kw of new capacity in the next decade, said R. K. Fischer, Westinghouse. Aerodynamics research at the new steam laboratory is directed toward improving designs based on fluid flow theory. Losses in the flow path, he said, are 70% of total losses in a modern steam turbine.

General Electric's G. B. Warren sees possibility of economic gains in larger condensers and exhaust ends. And the gas turbine offers promise of replacing draft fans on supercharged boilers with an economical addition of 15% plant capability.

The once-through steam generator is well adapted to supercritical pressure, said A. T. Hunter, Combustion Engineering, Inc. As proposed for Philadelphia Electric's 276-Mw plant, a boiler of this type will produce 1.54-million lb per hr of steam at 5,000 psig 1,200 F. Superheating and reheating take 65% of total heat input, compared with 40% in a typical 1,800 psig 1,000 F/1,000 F design. Reheat temperature will be controlled by burner tilt. Design follows practices well tested at 1,500 to 2,300 psig in 30 European installations with over 2-million service hours.

Oxygen must be removed from its feed water, continued Hunter. Organic additives, such as morpholine or hydrazine, may be required. Condenser leakage must be eliminated, although a bypass demineralizer serving nor-



NUCLEAR POWER'S GROWTH to be rapid, predicts W. K. Davis

mally as a blow down will remove small amounts of solids.

Supersized high-pressure boilers, capable of producing upwards of 1-million lb of steam per hour now number about 125 in service or under construction. Despite overloads of 10 to 15%, said G. V. Williamson and J. K. Bryan, Union Electric Co of Mo., availability has exceeded 95%. Inspection periods match outage schedules for turbine generators, which saves operation expense. And maintenance expenditures have been low.

Gas Turbines Supplement Steam and Nuclear . . . Gas turbines will be used in a number of steam-turbine plants, H. B. Wilson and A. A. Hafer of the General Electric Co reported. The combined steam-gas turbine cycle will provide worthwhile increase in overall plant efficiency. It will use the hot exhaust gas of the gas turbine: to heat feedwater, to generate steam, as combustion air for the boiler, and in a supercharged boiler system.

Gas turbines can also be combined with nuclear power plants to take advantage of the best features of each and overcome some of the difficulties, reported H. E. Grantz and B. H. Neuffer, General Electric Co. They described four different cycles. It was reported that output of a boiling water reactor can be increased 107% with only 25% more capital investment by using a gas turbine in a topping or superheating cycle. Several of the combined cycles appeared to warrant further detailed study.

Adding regeneration to the simple cycle gas turbine has improved efficiency some 25%, said J. O. Stephens and D. F. Bruce, Westinghouse. They claimed that this development places the 5,000-hp gas turbine between the 5,000-kw steam turbine and the diesel plant in efficiency.

Diesel electric generators must have operating performance features that complement and improve the electric utility steam in order to fit into the utility picture, said K. O. Bower of General Motors Electromotive Division. Bower and E. A. Armstrong described the low cost per kw and automatic operation of General Motors' new mobile generators which, they said, make these units suitable for many applications.

Heating Loads Balance Air Conditioning . . . Electric heating and year-round air conditioning were given by Fischer Black, Electrical World, as possible solutions to low load factor from rapid growth of air conditioning. Black suggested that both the heat pump and resistance heating be promoted and said the market could be reached by selling the benefits of electric heating. With this, he said, the industry's dream of the truly all-electric home is a reality.

MODEL OF ATOMIC POWER PLANT proposed by North American Aviation Co gets the attention of John Endres and T. E. Palmer of S&C Electric at the exhibits

Common denominators to interests of utilities, residential customers, and electrical manufacturers are service voltage and customer's wiring, said H. H. Watson, General Electric Co. Boosting the voltage above 120 to ground raises questions of safety, interchangeability of portable appliances, lamp life and efficiency, availability of appliances for two voltages, and increased cost to the home owner. He foresees no home device which cannot be served adequately with 120 or 240 v circuits installed in accordance with the National Electrical Code.

Future distribution demands of 10 to 15 kw were foreseen by H. E. Lokay, Westinghouse, for homes with air conditioning or electric heating. The average will reach 3.4 to 3.8 kw by 1985 with only ranges, freezers, refrigerators, and dryers, he said. Users will demand better reliability, proper voltage, flicher-free service, and lower rates, he predicted.

Existing Plant Can Serve New Loads . . . But existing No. 2 secondary mains with 75-kva transformers can serve loads of these magnitudes, Lokay continued. Banking secondaries permits serving large motors, and 480-v or 3-ph service for this purpose have not yet been proved desirable.

Today's lower voltage distribution cannot be condemned as obsolete, said Olmsted, Electrical World, unless it can be replaced or revamped to serve its customers better or cheaper. But the trend to higher voltage and larger feeder ratings will bolster demands for economical solution of service reliability.

The deepest shadow of obsolescence falls on house service connections and metering. For these, Olmsted, reported 15 million meters inadequate and another 11 million "doubtful."

Engineering Research Succeeds . . . "Engineers have done an outstanding job . . . They are not only making great progress, but they may be making it faster than many other industries which get more publicity . . ." Thus spoke EEI President Harold Quinton. He predicted that technological advances would continue as long as political and economic atmospheres permit individual creativeness.

Achievements in growth and technical excellence appear to answer the question of whether the electric utility industry has devoted enough attention and money to research, Howard P. Seelye, Detroit Edison, told the general session. The research organization within the EEI is already set up to do this, said Seelye.

Growth of new technology, during and since World War II, has been almost explosive, said C. H. Linder, General Electric Co. Yet of those rated in the top 10% in army intelligence tests only 42% graduate from

(*Continued on page* 232)

EEI'S QUINTON
"Balanced load curves"

AG&E'S SPORN
"Heat pump's a must"

ECONOMIST BACKMAN
"Keep earnings healthy"

GE'S CORDINER
"Longer-range planning"

EEI Sales Conference Discusses . . .

How Can Sales Mold Better Returns?

- **Cost of doing business continues upward . . . summer load peaks, lower load factors are making it tough to improve earnings, attract investment**
- **A possible solution offered: Redirect selling efforts with new emphasis on heating, lighting, farming and other valley-filling loads**

Whether or not the industry will continue to grow is not the question anymore. Instead the problem is how can that growth best be molded?

This, at least, seemed to be the crux of the speeches and hallway conversation among utility salesmen at Edison Electric Institute's 21st annual sales conference in Chicago late last month.

Concern was voiced with how the sales force can work to assure favorable earnings as expanding utilities must continue to spend to meet the obligations they have to their customers. With this problem came related ones: What to do about summer load peaks? Inadequate wiring? The lagging farm, lighting and commercial cooking markets? How to improve load factor?

Economist Jules Backman of New York University declared that with the business outlook good, sales of electric power will continue to expand with "unabated vigor." This will necessitate installation of a substantial volume of new capacity requiring large amounts of additional capital, most of it from private investors. "It is of vital importance," he said, "that the earnings position of the industry be kept healthy."

Selling Shift . . . To Philip Fleger, chairman of the board, Duquesne Light Co, a basic shift in selling emphasis is warranted. This means a swing from pushing increased volume to promoting sales which have the most beneficial effect on load factor. "With improvement in our heat rate leveling off," he said, "and with little opportunity to reduce reserve capacity, increased load factor offers one of the most effective means of reversing the downward trend in our rate of return."

American Gas & Electric Co's President Philip Sporn held out year-round air conditioning, the heat pump in particular, as the means of gaining the all-electric home, and with it better system load factor. Summer air conditioning, which is apt to have a high demand and low annual load factor, will continue to be "a difficult load to serve," he maintained. The obvious solution is to develop winter load and this logically means electric heating. Annual load factors of 6-15% expected for cooling only could be upped to 20-25%.

Lighting, Too . . . Increased lighting promises better load factor, too, declared Merrill E. Skinner, vice president, Union Electric Co of Missouri and James C. Forbes of General Electric Co's Lamp department. Skinner offered such reasons for promoting it as unlimited potential ("we have a long way to go to match sunlight"), good load characteristics, no competition.

But all this load development and equipment sales talk still hinges on licking the "inadequate wiring problem," pointed out J. H. Jewell, vice president of Westinghouse Electric Corp. He presented the "joint action" wiring promotion kit (developed by National Electrical Manufacturers Association and allied groups) introduced at the recent National Adequate Wiring Conference.

New Wiring Committee . . . Then EEI announced a new committee to explore what its utility members can do to "more effectively promote" adequate wiring. Committee, with members yet to be named, will be headed by Harry Restofski, vice president of West Penn Power Co.

As a backdrop to these proceedings, General Electric

CHAIRMAN DOERR
"Weak spots in armor"

WESTINGHOUSE'S JEWELL
"Joint action for AW"

REA'S NELSEN
"Let's join hands"

DUQUESNE'S FLEGER
"Shift sales emphasis"

Co's President Ralph J. Cordiner told utilitymen his ideas of what the industry must do further to stimulate electrical growth: First, adjust its sights to longer range planning; second, give the necessary recognition and compensation to attract and hold the industry's best young people.

Good Job . . . All speakers paid tribute to the job utility sales forces and EEI's commercial organization are doing to develop electrical living. EEI President Harold Quinton expressed conviction that sales planning "will hold the load curves in balance and assure adequate net income in the years ahead." O. R. Doerr, vice president Pacific Gas & Electric Co, and chairman of EEI's Commercial Division Executive Committee, however, noted that there still "are many weak spots in our armor. Far too many of our selling efforts do not measure up to the standards of aggressiveness required to meet the needs of our rapidly expanding industry," he said.

In the two days preceding the general sessions, EEI's various commercial committees held workshop meetings. Reports of what transpired follow:

Farm Sales

- More Company—Co-op Cooperation, asks Nelsen
- More end—use research study, says retired executive
- Sell to the farmer with participation techniques, says utility man

"Let's join hands" Administrator Ancher Nelsen of Rural Electrification Administration, urged a special luncheon audience, in discussing rural power use development.

The first REA chief ever to occupy an EEI speaker's post, Nelsen told utility farm specialists in attendance to turn their backs on grudges and build the machinery for getting action.

Get Farmer to Participate . . . At their regular working sessions, the farm group turned its attention completely to promotional "how-to's." John E. Canfield, vice president of Wisconsin Power & Light Co, saw the farm market as a "splendid" opportunity to build profitable load without materially increasing plant investment. To promote it, he suggested a participation, or what he called a "You Are There" technique: demonstrations, shows and meetings in which farmers and their families are invited to participate.

"Learn to understand the farmer better, it will save time and grief," declared C. H. Leatham, retired executive vice president of Monongahela Power Co. "Let's do more research and study more carefully the end use of our service rather than the means exclusively."

A five-man panel, moderated by Bud S. Moss of Georgia Power Co closed the session. From it came these reports:

- New York State Electric & Gas Corp and Union Electric Co of Missouri are promoting milk consumption through a series of newspaper ads, TV programs, and news stories;
- Carolina Power & Light Co is conducting contests in land use practices as a means of promoting soil conservation;
- Southern California Edison Co has held chicken weight-guessing contests to promote use of infra-red lamps for brooding;
- Georgia Power Co has helped to develop a refrigerated egg cooler and already has sold 119 units;
- Pennsylvania Power & Light Co, in a program directed

ADEQUATE WIRING: AW Bureau's Norman Wicks talks with Reed Hartman, industry's coordinating committee chief

"... More research and tighter coordination in selling are needed ..."

at low-use customers, sold 60,000 heat lamps each of which will bring in an estimated $8 in revenues during the life of the lamp. Campaign also pushed sale of dairy water heaters.

Commercial Sales

The points from this session:

- More research needed to determine what loads are profitable
- Nearly one-third of commercial-industrial air conditioning market will be heat pump prospects by 1964
- Water heating is powerful sales adjunct to commercial cooking

In probably the most studied presentation of the conference, Constantine Bary of Philadelphia Electric Co opened the Commercial Session by showing how research can more closely control and assure profitable load building efforts. Bary, an economic analysis engineer, discussed the relationship of the small manufacturing and commercial class of customers to other classes of service. To build profitable loads in this classification, he set down these principles:

First compare cost of service and pricing structure over the complete range of the customer's requirements;

If comparison does not show a good fit, correct it but meanwhile confine load building to those regions where the rate structure is fully compensatory;

Fluid, variable load factors are the rule in the small industrial-commercial class. This dictates use of demand-type rather than block-type rates. One cannot make the unqualified assumption that increases in customers' size, or load factor will result in overall economic improvement of the class, or of the system;

Thus it does not seem practical, or desirable, with such a heterogeneous class of customers, and demand and energy usages, to circumscribe load building activities to any set of appliances or applications. If cost of service and price structure fits well, uniform load building is best. If not, be selective.

Commercial Heat Pump Market Big . . . Foreseeing a broad commercial and industrial market for air-to-air heat pumps in the next 10 years, H. M. Brundage, manager of General Electric Co's Weathertron department, urged utilities to make their marketing plans now. By 1964, he said, 32% of the year-round air conditioning prospects in this market will be ripe for heat pumps.

Commercial cooking claimed its share of the attention too. Ohio Edison Co's C. E. Sperow pointed to electric water heating as an additional and relatively undeveloped sales possibility in the food service industry. He said that EEI right now is readying commercial water heating data sheets similar to those for commercial cooking. They will be available next year.

"The electrical contractor, with proper training, can be converted into a constructive lighting salesman for the utility, pointed out H. F. Huerkamp, Westinghouse Electric Corp and chairman, executive committee, National Lighting Bureau. He noted that the commercial-industrial lighting market is sadly in need of some salesmanship (only 20% of present installations meet IES min intensity standards). Certification of lighting by qualified contractors, trained and pre-sold through active, local Certified Lighting Programs, was his answer.

Industrial Sales

Speakers at Industrial Sessions brought these points:

- That electric air conditioning will sell in the face of high-pressured competition because of its advantages
- That leasing industrial equipment is one way to "get those kilowatts used fast," but that machinery preferably should be bought now
- That a bright and growing future for induction heating lies on the horizon of technology, particularly in processes of stress-relieving

Ben R. Askew, Georgia Power Co's manager of Industrial Power Sales, said plenty of money lies in the air conditioning load.

Keep On Toes . . . But the power salesman must get to the prospective customer quickly. Despite local gas rates of 18 to 23 cents per 1,000 cu ft, with but two exceptions "every job which my company has lost to competition was lost because we were not on the job soon enough."

When to Lease Machines . . . Frank Griesinger, assistant treasurer of Lincoln Electric Co, Cleveland, said if machinery costs too much to be bought outright, leasing is one way to get the equipment, yet free capital for investment in other profit-making ways.

Leasing does not cut taxes under the new bill, he said. It merely postpones them. Be wary of long-term plans, because the government may not allow depreciation at the rate advertised by the loan agency. When a purchase option is written into the lease, make certain the fair market value of the machine is included also.

On the Horizon . . . Annual sales of induction heating equipment have jumped from $250,000 in the mid-thirties to $12,000,000 now. Dr Harry B. Osborn, Jr., technical director of the Tocco Division, Ohio Crankshaft Co, Cleveland, said 60-cycle is widely used on cross-sections up to 5 in., but that stress relieving, which does in minutes what it takes an hour or so in a furnace, will come more to the foreground in the future.

Residential Sales

From the Residential Session came this:

- Effective campaign coordination needs greater advance planning so everyone can get in the act
- Discounting may force more utilities back to merchandising and servicing

When every utility and every phase of the industry promote the same campaign at the same time then we will have real coordination to carry electrical living forward, Robert L. Coe, chairman of EEI's Residential Promotion

(*Continued on page* 162)

FIG 1-How Power Cost Varies With % Generator Loading

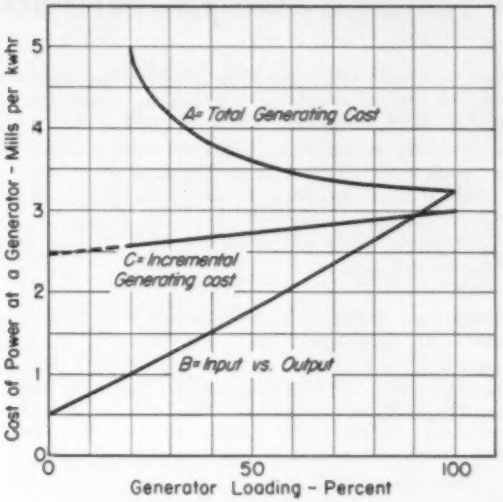
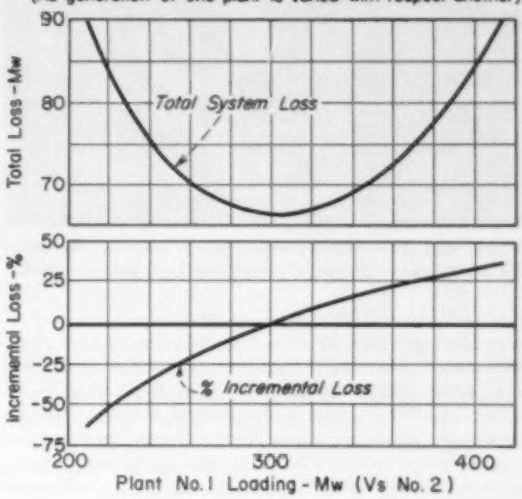

Cost of Power at a Generator - Mills per kwhr
A= Total Generating Cost
C= Incremental Generating cost
B= Input vs. Output
Generator Loading - Percent

FIG. 2-Relation Between System-and Incremental Loss
(As generation of one plant is varied with respect another)



In Economic Dispatch Today . . .

Coordination of Losses Is Vital

Incremental fuel costs and transmission losses are defined and expressed in practical formulas for inclusion in calculating system generation schedules

W. R. BROWNLEE, Chief Systems Study Engineer, Southern Services, Inc, Birmingham, Ala.

Coordination of incremental generating costs and incremental transmission losses is a powerful tool today for improved planning and operation of power supply systems. Methods of determining incremental fuel costs as a function of fuel prices and variable boiler-turbo generator characteristics have been used for many years, but practical formulas for determining incremental transmission losses in a power system network were largely unknown 12 years ago.

Further improvements in formulas and methods are proceeding. Study has been accelerated by an increasing awareness of operating savings obtainable through coordinated operation, amounting to $50 to $200 per hr in a typical transmission system. Such savings are not realizable in a perfect incremental fuel dispatch which ignores incremental transmission losses.

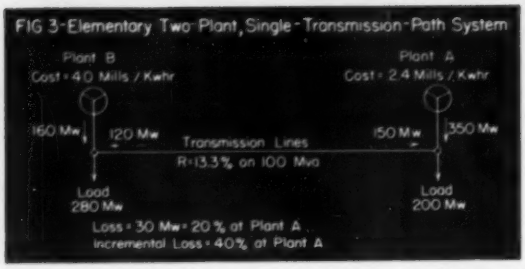
Recognition of transmission losses ranges today from use of a transmission-loss factor for plants more distant from the load to a complete operating computer providing up-to-the-minute overall incremental costs for dispatching the power system. In the present fluid state of the art it may help here to review the elements of the coordination problem, including the meaning of incremental generating costs and incremental transmission losses; to develop certain basic concepts for relating the value of power at different locations on a system; and, to outline the application of general principles to operating and planning problems of a power system.

Optimum Economy . . . Assigning maximum loading to units of low generating cost, or loading plants to produce the lowest transmission loss, seldom results in the best economy. Optimum operating economy is had when the cost of generating enough power at any plant for delivery of a small unit of power to a chosen reference point is the same for all plants in the adjustable range (operating between maximum and minimum loading). This reference point may be any plant or substation on the system, or it may be the composite system load.

The nature of variations in the cost of power at a generator is illustrated in Fig 1 as a function of the percent load carried by that generator. Generating costs, include the cost of fuel, variable maintenance, and certain supplies, along with other expenses, which are a function of the amount of generation. Curve A shows total generating cost which decreases from 5.05 to 3.35 mills per kwhr as generation is increased from 20 to 100%.

Curve B is the "input-vs-output" curve. For any specific boiler-turbogenerator, such curves may be plotted as total (equivalent) thermal input in Btu per hr vs total output in the same units. By applying proper constants, the input scale may be made to read in terms of dollars per hr. Furthermore, the relationship may be generalized by assigning an input scale of mills per hr per rated kw and an output scale of percent (or per-unit) loading.

For example, if Curve B is applied to a 100-Mw unit, the operating cost is $325 per hr at full load and $180 per hr at half load. Curve B may be plotted from the basic data used to compute Curve A, or it may be obtained by multiplying the values of Curve A by the per-



ECONOMIC BALANCE between plants may be illustrated by elementary two-plant, single-transmission-path system

unit loading. Curve C is roughly the slope of the input-vs-output curve and represents incremental generating cost, or the cost to supply a small unit of power at a generator as a function of the percent load carried by that generator. This cost varies from 2.6 mills per kwhr at 20% load to 3 mills at full load. The equivalent of Curve C must be used for all steam generating units which are required to be in operation. These curves are determined solely by circumstances existing at the location of each generating unit.

Fig 2 shows the relationship between total system loss and the incremental loss at one plant (No. 1) as the generation of that plant is varied with respect to another plant (No. 2). While calculated separately, the incremental loss curve is approximately the slope of the total loss curve. These curves are the resultant of all system loads, generations, interconnection flows, voltages, and the network of transmission lines.

Two-Plant Comparison . . . Another basic criterion may be used instead of the comparison of overall power cost f.o.b. some reference point. Economic balance is achieved when the cost of generating a sufficient amount of power at Plant A to deliver a small unit of power at Plant B is the same as the cost of generating that small unit at Plant B, and when all pairs of variable plants are so balanced. In the elementary two-plant, single-transmission-path system in Fig 3 the incremental generating cost of Plant A, including fuel and variable maintenance, is 2.4 mills per kwhr and that of Plant B is 4 mills per kwhr.

Plant A is generating 150 Mw more than its local load and delivering 120 Mw at Plant B with a loss of 30 Mw, or 20% of the transmitted power. Because of the simple quadratic relationship, the incremental loss at Plant A for power transmitted to Plant B is about 40%. That is, with an initial flow of power, P, the initial loss is P^2R and the per-unit initial loss is PR. When a small increment of power, ΔP, is added, the new total loss is $(P+\Delta P)^2R$, and the added loss is $2P\Delta PR$ since ΔP^2 is small. The per-unit incremental loss is 2PR, or twice the original per-unit loss. Consequently, when an additional kw is generated at Plant A, only 0.6 kw is received at Plant B. The cost of additional generation at Plant A to deliver 0.6 kw to Plant B is 2.4 mills per hr, and the cost of generating 0.6 kw additional at Plant B is 0.6 x 4, or 2.4 mills per hr. So these plants are in economic balance.

When it is assumed that the incremental generating costs of both plants remain constant as generation varies, the total cost of delivering 120 Mw to Plant B from Plant A is 150 x 2.4, or \$360 per hr. This contrasts with the cost of supplying 120 Mw by generation at Plant B, which would be 120 x 4, or \$480 per hr. Thus the operating saving is \$120 per hr over the cost of each plant generating its own area load. If the generation at Plant A were increased, replacing Plant B generation, until the total loss were 40%, the total generating cost at both plants would be the same as if each plant generated its own area load.

Fundamental Concepts and Definitions . . . Modern methods are progressing toward good solutions of incremental losses in a complex power system network. Understanding of these methods is aided by a review of fundamental concepts and definitions.

M_{12} is the incremented loss incurred by transmitting power from location 1 to location 2 as a fraction of the incremental power at location 1. This is sometimes called dL/dP_{12}.

N_{12} is the incremental power delivered at location 2 from location 1 as a fraction of the incremental power at location 1. It also expresses the economic energy cost ratio, or the optimum ratio of the cost of energy at location 1 to that of location 2.

M_{1L} is the incremental loss incurred by transmitting power from location 1 to the composite system load as a fraction of the incremental power at location 1.

N_{1L} is the incremental power delivered to the composite system load from location 1 as a fraction of the incremental power at location 1.

Note: These are sometimes given as N_1 and M_1, or dL/dP_1, but the full significance of the double subscript should be inferred.

C_1 is the incremental generating cost, including variable maintenance, of power of a plant at location 1, approximately equal to dF_1/dP_1.

V_1 is the incremental value of power at location 1.

V_L is the incremental value of power at the composite system load when the system is in economic balance.

It is apparent that $C_1 = V_1$ when the system is in economic balance, and when Plant A is operating within its variable range. The following relationships are axiomatic and exact:

$$N_{12} = 1 - M_{12} \quad (1)$$

$$N_{21} = 1/N_{12} \quad (2)$$

$$N_{12} \times N_{23} = N_{13} \quad (3)$$

$$M_{21} = 1 - N_{21} = 1 - (1/N_{12}) = -M_{12}/(1 - M_{12}) \quad (4)$$

$$N_{12} = N_{1L} \times N_{L2} = N_{1L}/N_{2L}, \text{ or } N_1/N_2 \quad (5)$$

$$M_{12} = 1 - N_{12} = \frac{N_2 - N_1}{N_2} = \frac{M_1 - M_2}{1 - M_2} \quad (6)$$

$$V_2 = V_1 \times N_{21} = V_1/N_{12} \quad (7)$$

The arithmetical relationships demonstrated for Fig 3 may be formalized as:

$$V_B = V_A/N_{AB} = C_A/N_{AB} = 2.4/0.6 = 4.0 \text{ mills/kwhr} \quad (8)$$

But $C_B = 4.0$ mills/kwhr

# of Fuel-Transmission Coordination Given

Therefore, Plants A and B are in economic balance.

A general equation relating all costs to the system load may be written:

$$V_L = \frac{C_1}{N_1} = \frac{C_2}{N_2} = \frac{C_3}{N_3}, \text{ etc.} \qquad (9)$$

where all plants are in the variable range. If C_1/N_1 exceeds V_L, Plant 1 should be operating at minimum load. Similarly, if C_2/N_2 is less than V_L, then Plant 2 should be generating maximum output.

Use of Equations . . . Equation (5) or (6) facilitates determining the incremental loss between any two points on a system when the incremental loss is known from these points to the system load. Equation (7) permits determination of the value of incremental power at any location from any other location where a plant is in the variable range (and therefore C = V at the reference location).

For example, when Plant 3 has an incremental generating cost of 3 mills per kwhr, its incremental loss to the system load is 30%, and the incremental loss from Interconnection 4 to the system load is 20%, the value of incremental power at Interconnection 4 is

$$V_4 = V_3/N_{34} = V_3/(N_3/N_4)$$
$$= 3/(0.7/0.8) = 3.43 \text{ mills/kwhr.}$$

The average value of a block of power at any location will be approximately the average of the incremental values at that location before and after the power is transferred. For any given condition, the adequacy of this approximation may be checked by computing incremental value at intermediate points also, such as 25, 50, and 75% of the block of power to be transferred.

Determination of incremental losses either between plants or from plant to load is seldom as simple as in Fig 3. In that system, the loading of the single transmission path can provide complete information on the incremental losses between plants. Usually the operating information available to the coordinator is the generation carried by each plant. If system loads supplied at A and B vary in some predetermined relationship, it is apparent that the loading of line A-B, and therefore the incremental loss, is some function of the generation of Plants A and B.

If a new plant, C, is connected at the midpoint of the line A-B and supplies a similar amount of power to Plant B, the incremental loss from A to B will be about 1½ times its former value, since the incremental loss in percent is nearly a linear function of the initial equivalent line loading.

Thus, even with a strictly repetitive load pattern, incremental losses from any one plant to the system load, or from any one plant to another plant, will be influenced by the power supplied by every generating plant and interconnection.

Planning Expansion . . . Although attention has been focused on power system operating savings, proper planning of power system expansion requires consideration of comparative losses of both capacity and energy. Readings from a network analyzer, customarily used in such studies, can provide line current readings from which total losses may be calculated. But these have little meaning unless the line flows result from a generating schedule providing a reasonable balance of generating costs and transmission losses.

The various systems of matrix constants are too cumbersome for the rapid determination of such a balanced dispatch needed for the several loadings required for each alternative plan.

The phase-angle method, however, in effect reduces each pair of plants to a simplified two-unit system, as the phase angle between a pair of plants is the resultant of all generations, loads, and voltages on the system. For system planning purposes, the transfer impedances many be measured between pairs of plants, or to a reference plant, so as to provide a value of the reactance/resistance ratio.

An estimate of this ratio may suffice for preliminary studies.

Values of voltage phase angle for any assumed preliminary dispatch may be read directly on the network analyzer, and the generation adjusted by rapid approximations to satisfy the equation

$$\frac{C_1}{C_2} = \left(\frac{K - \tan \tfrac{1}{2}\theta}{K + \tan \tfrac{1}{2}\theta}\right)^2, \text{ etc.}$$

where θ is the angle by which the voltage at Plant 1 leads the voltage of Plant 2, and K is the reactance/resistance ratio of the (open-circuit) transfer impedance between them.

The working curves plotted for various values of θ and K facilitate rapid adjustments. By studying two or three system loads other than the peak, a realistic annual energy dispatch of new and existing generation and corresponding losses may be obtained for each alternative plan for system expansion.

Operation Coordination Constants . . . Operating coordination, whether of the prescheduled or continuous computing type, usually relies on a series of constants. These are used with the generation at every plant for deriving the incremental losses from one plant to the load. That is, the customary formulas provide values of M_1, M_2, etc. Methods being developed for deriving adequate sets of constants for determining incremental losses, while intriguing, are beyond the scope of this article. None is really scientific except in a "broad-brush" way.

In general it may be said, the more formidable the formulas and the higher the saturation of Greek letters, the more fantastic are the assumptions concerning power system behavior.

Nevertheless certain of these methods deserve confidence. Network analyzer studies of complicated systems have provided verification of calculated changes in losses with substantial exchanges in generation. Recent analyses of small systems by superposition have supplied verification of loss differences with power transfers small enough to represent true incrementals. The economic importance of generating cost-transmission loss coordination justifies substantial additional study.

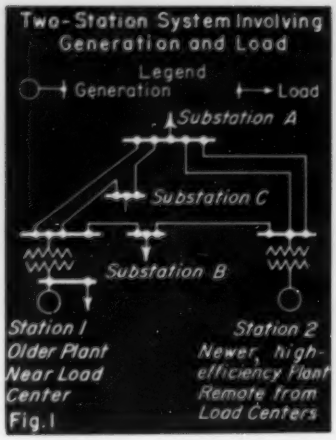


Fig. 1

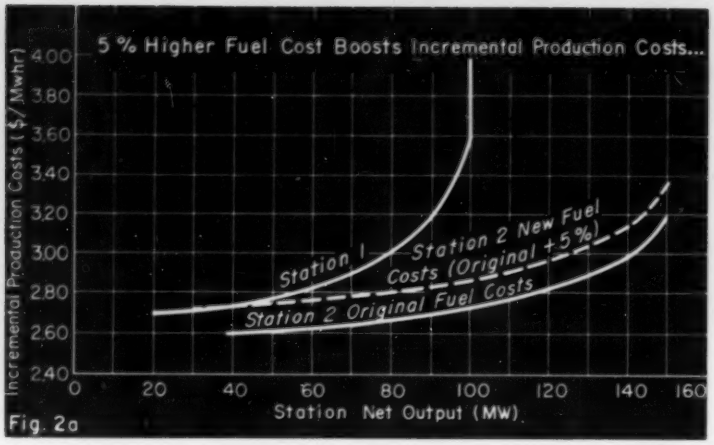


Fig. 2a

Management Faces Decisions

Choice between use of curves or computer should be based on transmission loss magnitude

D. C. HARKER and **M. C. WESTRATE**, System Planning Section, Commonwealth Associates, Inc., Jackson, Mich.

New methods and tools are available today for providing the bases for maximum economy in dispatch of power generation, and management must make several decisions regarding their use on a particular system.

"Economic dispatch" implies that incremental transmission losses and fuel costs have been coordinated in determinating the minimum cost of delivered power for each load condition. This concept, along with modern means to implement it, is a major improvement over previous dispatching.

Management faces the several choices in application, and there is no precise formula for the final decision among methods. Study to determine the incremental costs of generation and transmission remains a prerequisite, no matter what means of economic dispatch is ultimately selected for the system.

Incremental Replaces Average . . . Use of incremental instead of average costs of generation is now fully recognized. Whether transmission losses are large enough to warrant their evaluation in determining the dispatch of generation depends, however, on the particular system arrangement. In some systems, transmission losses are relatively small compared with production costs, and it is obvious that they do not materially affect economic dispatch. In other systems, trial calculation must at least determine the effect of incremental transmission losses.

When losses are significant in determining cost of delivered power, the first step is preparation of a loss formula for the system. This should be followed by coordinatoin of incremental transmission costs with in-

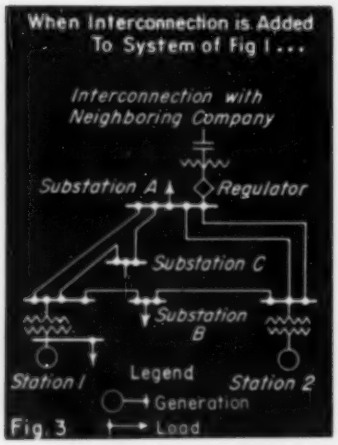


Fig. 3

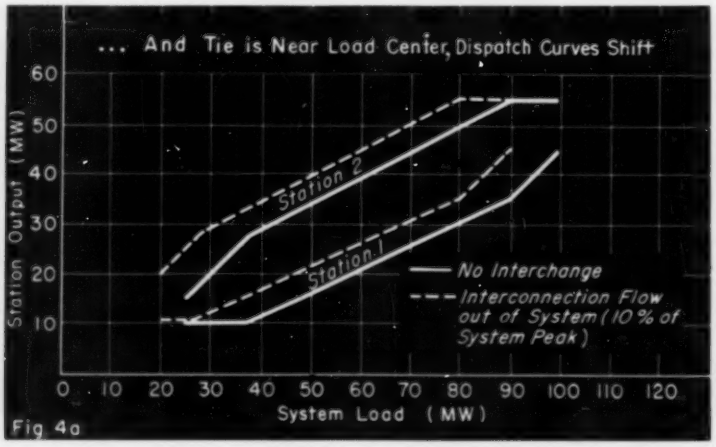
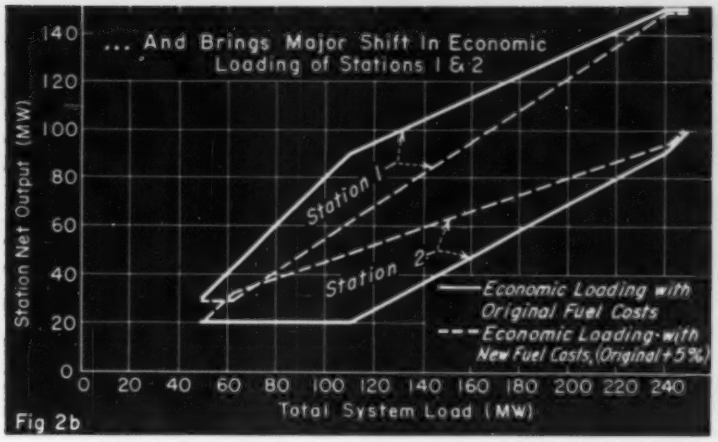


Fig. 4a


... And Brings Major Shift In Economic Loading of Stations 1 & 2
Station Net Output (MW)
Station 1
Station 2
Economic Loading with Original Fuel Costs
Economic Loading with New Fuel Costs, (Original + 5%)
Total System Load (MW)
Fig 2b

TYPICAL SYSTEM had older plant near and new plant away from load center. Curves apply to various combinations of generating conditions on system

On Tools for Economic Dispatch

on particular system, changeability of production costs, effects of interconnections, hydro

cremental station production costs so that a set of economic dispatch curves may be developed.

Curves or Computers . . . A number of these curves may be prepared, depending on the probable combinations of generating units out of service for a particular fuel cost. A new set of curves is needed for a system change or a revision in fuel cost. The time required to make these dispatches, using modern calculating equipment, such as digital computers, can be determined after the trial dispatches. The frequency of change in fuel costs, system generating combinations, and interconnection flows will point to the method best suited for continuous dispatch.

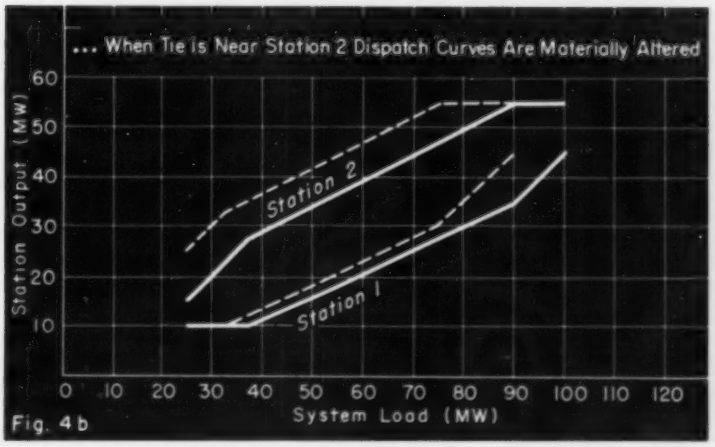
At this point, a decision must be made between these alternatives:

1. Revising the dispatch curves to keep up to date, or

2. Installing a dispatch computer on which these variables can be very quickly changed.

In any event, the loss formula constants are required either for determination of the curves, or for calibration of the computer, and these values must be kept up to date with system changes.

Several dispatch computers have been or are being built to determine economic loading immediately after adjustments have been made either manually or automatically. Some designs determine only the incremental transmission loss factor; others give the incremental cost of delivered power, including both transmission and production costs. Some balance themselves automatically for an equal cost of received power from all variable sources so that the economic loading for each station can be read directly. It is expected that some future computers will automatically regulate plant loadings through the use of present load control systems.


... When Tie is Near Station 2 Dispatch Curves Are Materially Altered
Station Output (MW)
Station 2
Station 1
System Load (MW)
Fig. 4b

ADDED INTERCONNECTION changes generation conditions on the system which are expressed in the curves. Plural interconnections complicate problems

System Is Key to Economic Loading Decisions

(*Continued from page* 00)

Factors . . . Consideration of a small system, illustrating the more important factors in economic loading, may assist management in reaching a decision on the most suitable approach to any particular system. The principle for coordinating incremental production costs for a simple two-unit system was previously outlined in "Modern Power Dispatch Evaluates Line Losses," (EW, Nov. 29, 1954, p 80).

A system typical of many is shown in Fig 1. System generation, with an older plant near the load center, has been increased by construction of a new high-efficiency plant some distance from the city with transmission-line connections to several load area supply substations.

For this system, a series of curves can be readily determined, covering combinations of generating units in service, changes in fuel costs, and other variables, such as nonconforming industrial loads. Of particular interest is the effect of relatively small changes in fuel cost at one plant only. Fig 2a illustrates the incremental production costs based on fuel costs at one condition (solid line) and with a 5% increase in fuel cost at Station No. 2 (dashed line).

The effect of this change in fuel cost is reflected in the revised dispatch curves of Fig 2b. The relatively small increase in fuel cost at Station No. 2 results in a very large decrease in the economic loading of Station No. 2, with a corresponding increase in output of Station No. 1. Although the direction of these changes are expected, their magnitude may not be appreciated.

The example stresses the importance of having accurate production costs. It is evident from the large change in dispatch curves that many thousands of dollars may be saved through this information.

Interconnection . . . An interconnection even on a relatively small system introduces factors which may require thorough analysis and inclusion in dispatch. Addition of an interconnection, as shown in Fig 3, might be treated as another source for the purchase of power, or it may be considered as non-conforming load for the sale of power. Cost of power at the interconnecting point may be an essential factor in determining when it is economical to buy or sell power.

When the interconnection point is near the load center, the net effect on the economic dispatch is merely to shift the horizontal axis scale as shown in Fig 4a. When the interconnection point is near one of the generating stations, the effect is a material alteration of the relative dispatch, as shown in Fig 4b, and it may be necessary to determine a set of curves for each block of power to be transmitted in or out of the interconnection.

The possibilities could become so numerous on a large system that precalculated curves are impractical.

The problem may be further complicated when there is more than one interconnection, and when power flow through the system is uncontrolled as in pool operations. Instances have been found where two interconnections are near the load center or otherwise so connected that flow between them does not appreciably affect the system dispatch. Such cases are probably exceptions. Where uncontrolled power flow between interconnections affects the economic dispatch, the use of predetermined curves becomes less practical because of the inability to predetermine the amount of flow.

Final Choice . . . From what has been said of the two-station system, it is evident that the number of stations is not the only factor in dispatch determinations. The principles nevertheless apply to more extensive systems. Whether pre-calculated curves or dispatch computers are required depends upon possible combinations of various factors and the frequency with which they change.

While application of dispatch computers may or may not be decided on clear economic grounds, here are some questions which must be answered before a decision is reached for a particular system:

1. Do production costs, particularly fuel costs, change frequently?

2. Do uncontrolled interconnection flows appreciably affect losses?

3. Is the cost of sale or purchased power required hourly?

4. Do certain large nonconforming loads affect the economic dispatch?

5. Is there appreciable hydro generation involved?

All these questions may be summed up in one: Is it feasible to use a predetermined dispatch? If the answer definitely is no, a dispatch computer will probably prove practical. When the system permits use of predetermined dispatches—and such systems are many—there is a choice among digital computers or desk calculators for determining dispatch curves.

Loss Formula Necessary . . . All dispatch computers available are based on and require determination of the same loss formula used for predetermined dispatch curves.

Determination and study of such curves will indicate characteristics of the system in terms of dispatch so that the requirements of the computer for the system are known before a large investment is made. The use of precalculated dispatch curves should be superseded only when it has been found that they are inadequate. The additional annual cost of a dispatch computer over the cost of preparing revised curves should be justified by the additional savings which may be expected with more rapid application in daily dispatch.

Personal Judgment . . . Determination of incremental costs and the loss formula, and application to power dispatch through curves or a dispatch computer, may result in large savings. Major improvements in fuel economy have been reported by some operating systems, and the cost of the necessary studies and preparation of curves or other guides appears to be well justified.

These studies and methods result in new aids and new data for the dispatch supervisor, but can cover only the economic loading aspect of dispatching a power system. The problems of adequate generation to cover spinning reserve, area protection, and errors in load forecast remain for the decision of the dispatcher. There is no indication that curves or computers will not depend on the individual dispatcher for intelligent interpretations and decisions in operation. Conditions he foresees, which cannot be expressed in curves or computers, must be considered along with the data these new tools furnish him.

Today's Power System Complexity Stresses Use of . . .

Digital Computers to Speed Studies

GLENN W. BILLS, Chief, Network Performance Unit, Bonneville Power Administration, Portland, Ore.

Digital computers afford utility engineers today a quick and easy means of analyzing complex power system problems. Within limitations of accuracy and complexity of the problem, they facilitate the solution of the following:

1. Load-flow studies.
2. Transient stability studies.
3. System losses.
4. Economic loading.
5. Automatic system control.
6. Transients in electrical networks which have non-linear elements.

While analog-type computers, such as ac network analyzers, electrical and electronic analog computers, and mechanical differential analyzers, contribute greatly to power-system analysis, digital analysis of important power-system problems is feasible and sometimes superior. A brief review of the limitations of analog computers reveals this.

Analog Analysis Becomes Difficult . . . In solving problems encountered in investigating system losses and economy loading, analog computers do not have sufficient accuracy. As power systems expand and interconnections multiply, it becomes physically impossible to set up complete analogs of systems on analog computers of practical size. Transient analysis of electrical circuits occasionally becomes extremely complex because of nonlinear elements, such as transformer magnetizing impedances. For such analysis it is not always possible to construct accurate models.

BPA Making Load-Flow Studies . . . Considerable effort is devoted to load flow analysis on digital computers, both in this country and in England. Two promising approaches are being investigated by Bonneville Power Administration's engineers. One is L. A. Dunstan's "track" method on systems involving as many as 58 loops ("Machine Computation of Power Network Performance," AIEE Transactions, Vol. 66, 1947, pp. 610-20). Dunstan has produced automatically printed load-flow diagrams using the IBM 602A calculating punch and a tabulator.

Dunstan reports a given set of loads can be converged upon with an accuracy greater than that of an ac network analyzer, although this method sometimes requires a number of iterations. His techniques permit a power utility with IBM or equivalent business machines to produce good load-flow studies without an ac network analyzer. His approach, aided by high-speed, large-storage digital computers, should easily compete with methods of load-flow analysis on ac network analyzers.

One possible deficiency of Dunstan's method is the difficulty of converging on a given set of loads. In studies involving many loads, his digital technique requires considerable experience and intuition. Load current changes must be anticipated when balancing the system to the desired values of loads. To overcome this difficulty, BPA engineers have tried to develop a load-flow analysis incorporating an automatic process for convergence.

Junction Analysis Shows Promise . . . Another means of describing an electrical network is through junction analysis which is easier to set up than the track method. Dr George Forsythe, Institute for Numerical Analysis, National Bureau of Standards, Los Angeles, suggested that use of node pair equations might be quite advantageous for load-flow studies done digitally. BPA has studied the programming of the solution of load-flow studies on the Standards Western Automatic Computer (SWAC) at Los Angeles.

To understand the junction or admittance approach, consider a simple network as shown in Fig 1. The electrical behavior (steady-state) of this

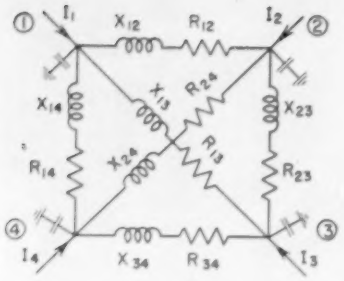


FIG 1—LOAD FLOW NETWORK is used in junction analysis. Network's steady-state behavior is expressed by a matrix equation

Y_{11}	Y_{12}	Y_{13}	Y_{14}
Y_{21}	Y_{22}	Y_{23}	Y_{24}
Y_{31}	Y_{32}	Y_{33}	Y_{34}
Y_{41}	Y_{42}	Y_{43}	Y_{44}

FIG 2—ADMITTANCE MATRIX for network is symmetrical. Junction analysis provides simple means of describing network system

network is expressed by the matrix equation $I_i = Y_{ij} E_j$. Voltages are those to ground from each point and currents may represent loads or generation. The admittance matrix, illustrated in Fig 2, is symmetrical. It can be shown that $Y_{11} = y_{11} + y_{12} + y_{13} + y_{14}$ and that $Y_{12} = -y_{12}$, etc. For this analysis y_{11} is the admittance to ground and y_{12} the admittance between points 1 and 2.

This scheme has the advantage of the simplicity with which a system can be described merely by looking at each bus and writing down each element of the admittance matrix. Should any of the network values be changed for later studies, the admittance matrix can be corrected quickly by adding or subtracting the appropriate admittances from the pertinent elements. Transformers and their tap ratios and phase shifters may be rigorously represented by equivalent pi's (π). This should be easier than representing them by equivalent impedances and series voltages.

Engineer Needs Guideposts . . . Utilizing such a scheme, it is possible to "cut and try" toward a solution. But convergence is slow and perhaps impossible unless the engineer has signs which guide him in making changes in load currents. Fortunately, a mathematical artifice exists appliable to such a problem. It is called "the method of steepest descents". This is a successive approximation device for solving sets of linear or non-linear equations.

Essentially, the process gives a vector indicating the direction toward a better solution. Although this method indicates residual error, the magnitude of correction to be applied must be approximated. A procedure has been devised which automatically chooses an appropriate correction magnitude.

Solving load-flow problems in this fashion eliminates the inversion of matrices which is always difficult for large systems. It is believed this type of load-flow analysis can be extended to cover fault calculations.

Many economic studies of transmission lines requiring accurate evaluation of both real and reactive line losses and circuit voltages are made at BPA. To facilitate this work, extensive tables of ABCD constants for varying line lengths, many line configurations, and various conductor sizes were made, using IBM equipment (EW, June 15, 1953, p129).

With this table of ABCD constants, it is possible to obtain hundreds of line loading conditions quickly and easily, using the IBM 602A calculating punch. Because of this digital application, conventional circle diagrams are no longer necessary. Furthermore, economic analysis is much more comprehensive and rapid.

Study Transients with Digital Computers . . . Transient stability problems can be done readily with digital computers, provided all necessary transfer impedance values are available. The usual assumption must be made that load impedances are constant. On the SWAC, four-machine transient stability problems using half-cycle intervals took less than 30 sec per set of swing curves.

Unit Like SWAC . . .

This time compares with two hours on an ac network analyzer for a less accurate study. Although programming time for applying this problem to the SWAC is greater than that for setting the problem on the analyzer, the computer is far superior when many swing studies are to be run.

The effects of generator excitation and governors can be included in transient stability studies done digitally. But transient stability problems for two or three-machine systems, including exciter and governor effects, can be made on electronic analog computers in 5 to 6 sec. Unfortunately, larger problems soon become extremely complex on an electronic analog computer.

To follow the progress of transient stability studies produced digitally, the swing curve for each generator can be shown by automatic plotters as the computations are made. If applicable, total power output of the generators can be recorded and used as a stability criterion.

Automatic Swing Studies . . . For utilities, having modern ac network analyzers, automatic swing studies are feasible on a digital computer of limited capacity. In the paper, "Analyzer Interconnections for Direct Determination of Power System Swing Curves," AIEE Technical Paper 54-14, a technique is described for making swing curves automatically, using a mechanical differential analyzer. But an electronic analog computer probably would be adequate. Possibly a more accurate method would be to substitute a digital computer for the mechanical differential analyzer.

Transmission-line losses have become increasingly important in the past 12 years. Large interconnected power pools have resulted in widespread interchange of power between companies to integrate steam and hydro generation. Accurate loss calculations are required to determine wheeling charges and obtain optimum operating efficiencies. Much progress has been made in developing practical and accurate formulas for computing system losses. Computations can be handled readily by high-speed digital computers. "Loss Formulas Made Easy," AIEE Transactions, Power Ap-

Can Feed Tabulated Solutions into an Electric Typewriter

paratus and Systems, August 1953.

Loss Calculations . . . Application by BPA of digital analysis to loss calculations has been limited to two cases. In the first, loss coefficients were calculated for a nine-machine system for an economy loading study at Massachusetts Institute of Technology on the Whirlwind I. The second case involved deciding whether the 230-kv Coulee Dam bus, into which feed 18 generators rated 120 Mva each, should be solid or split for normal system operation.

On a transient stability basis, either arrangement appears satisfactory. For load flows in transmission lines, however, the split bus gives slight line-loading unbalances. Real losses for these two operating conditions were obtained by digital methods to get sufficient accuracy for comparison purposes.

Knowledge of losses has made it possible for some utilities to operate steam plants and transmission systems with a minimum of over-all losses for most conditions. This economic loading problem could be done readily on digital computers. IBM type machines are used by Consolidated Edison Co of New York for part of the task, but American Gas & Electric Service Corp uses analog-type computers.

Hydro Economic Loading Problem . . . The economic loading problem has been solved satisfactorily for utilities whose main power sources are steam plants. But this is not the case for utilities depending primarily on hydro plants. Steam costs can be definitely allocated, but storage, head, stream-flow, and transmission-line losses are interdependent in arriving at a solution for optimum operation. Solution requires the application of calculus of variations and associated boundary conditions. To date, no publication describes a complete solution for economic loading of hydroelectric systems.

BPA had economic loading studies made at MIT through limited use of the Whirlwind I digital computer. Formulation of the problem was achieved, and programs were made for performing the optimization of the three-dam system and its associated transmission system on the computer. Progress was retarded because of data handling difficulties.

Successive iterations made on the problem produced reduced operating costs each time the water flows were rescheduled. This indicated that optimization was being approached. But, prediction of stream flows for long periods is not possible. Thus it is doubtful whether a successful solution of the economical loading problem as posed will be practicable. Because of this doubt, the work has been dropped.

Answer May Be Applied Theory . . . Intensive application of statistical theory, combined with a successful solution of the optimization problem, may be the ultimate method for achieving economical system loading of generators and lines. Digital computers appear to offer the best chance for a successful attack on this problem. With the exception of one electronic analog computer that has four and five-place accuracy, analog computers are not sufficiently accurate. The ultimate solution will require a digital computer which can make numerous load-flow studies, compute losses and loss coefficients, and determine optimum operating schedules.

A general-purpose digital computer with magnetic drum storage will be used by BPA to aid in scheduling water flows through federal dams on the Columbia River. This computer also will be used to solve problems of large electrical systems.

Economic Loading First . . . Automatic control of power systems is a step that will follow the solution of the economical loading problem. It is becoming almost physically impossible for dispatchers at large substations to grasp the significance of information and to act quickly to maintain the best system operating level. Semi-automatic load and frequency control systems now in use are far from perfect.

After long-range solutions to economical loading problems are made, they must be stored on magnetic tape, punched cards, or other devices. Short-range results, which cannot be determined prior to actual system operation, may have to be computed as system data are fed from outlying points. Various measurements, such as actual voltages, rainfall measurements, and power flows, will have to be translated into data which can be stored or fed into some type of computer. Possibly a digital computer could be used.

STANDARDS WESTERN AUTOMATIC COMPUTER has been used by BPA in load-flow studies

Computers Will Govern Directly . . . Information from computers will have to be stored or used so that it will issue direct orders to voltage regulators, dam gates, or hydraulic turbines without being delayed by transfer through a human servomechanism.

Because of recent development in computers, automatic control of systems is a reality. For example, Consolidated Edison operates its East River Plant from machine-tabulated data. The plant contains two 60-Mw and one 160-Mw turbogenerators. An IBM tabulating machine furnishes automatically and in tabular form information that tells the operator how to schedule load to achieve lowest operating costs.

SYSTEM OPERATOR'S OFFICE, Pine Bluff, calls upon most economical combination of power sources available hourly

Gas Prices Spur Economic Dispatch

Middle South dispatches system with capability of 2.25-million kw, employing the digital computer to solve basic transmission-loss, fuel-cost relationships

E. E. GEORGE, Electrical Engineer, Ebasco Services, Inc, Little Rock, Ark. and

E. C. STEWART, System Operator, Middle South System, Pine Bluff, Ark.

The Middle South System applies the principle of economic loading, involving consideration of transmission loss and incremental fuel costs, to today's power operations and uses the digital computer to solve fuel-and-loss coordination equations. The system which has a capability of about 2.25 million kw—about 10% of it peaking hydro—has 23 major steam units ranging in size from 15 to 125 Mw, and uses gas as its primary fuel.

Gas prices have advanced considerably in recent years so that during most months Middle South's fuel bill is well over $1 million per month. Furthermore, the growing complexity of fuel contracts has created problems in system operation, making it difficult for the utility, and incidently for the suppliers, to estimate the total amount and cost of gas to be sold in a year.

Middle South found it virtually impossible to determine the actual unit price or the quantity available for the various day-to-day operating conditions. Cumulative quantity discounts, cumulative consumption limits and other provisions failed to take into consideration the facts that a power system buys from more than one supplier and that fuel can be used economically only when the price at each location and from each supplier is known accurately before use.

More than five years ago, Middle South found the increasing cost of fuel sufficient incentive for studying the efficient loading of its generating plants with their variety of fuel costs and thermal efficiencies. As the system was then growing continually and generating capacity was being installed at new locations, it also became apparent that new loading schedules were needed to replace those made in 1951.

Other Incentives . . . Prospective use of automatic scheduling computers then appearing attractive, Middle South undertook to accumulate information on transmission loss and incremental costs. Such data were prerequisites to the putative purchase of a loading device and could be used for checking such a device against known optimum schedules.

Another development at this time made current loading schedules desirable. This was the cooperative program of Ebasco Service, Inc., its clients, and the International Business Machines Corp for developing ways of using accounting machines for calculating transmission loss and making emergency revisions in loading schedules.

Special Problems . . . The determination and application of economic loading for the Middle South System required solution of many problems, many of them new. Among these problems were the following:

1. Difficulty of setting up a large area in adequate detail for determination of a loss formula.

2. Desirability of preparing loss formulas for individual systems as well as for the combined Middle South System.

3. Desirability of setting up all radial loads so that total as well as incremental losses would be directly available.

4. Handling of sources which may or may not be scheduled by the Middle South System operator and preparation of economic data for such stations for use as a basis for appropriate inter-company purchase during periods when the plants are not coordinated sources of the system.

5. Frequent sales of power to interconnections in varying amounts and from varying sources with varying losses.

6. Handling of normally closed interconnections with Southwest Power

Administration, Empire District Electric Co, Oklahoma Gas & Electric Co, Southwestern Gas & Electric Co, Gulf State Utilities Co, Southern Co, and Tennessee Valley Authority.

7. Availability of company-owned peaking hydro which can be scheduled at will.

8. Existing contracts for SPA hydro which must be scheduled within kw and monthly or yearly kwhr limits.

9. Variable growth of different sections of the system.

10. A large amount of aluminum pot-line and pipe-line pumping load.

11. The need of spreading reserve over the system because of its large geographic area.

12. Necessity of having one or more large units out for overhaul during most of the year.

Methods . . . Problems 1, 2, and 3 above were met by setting up Middle South's four component systems in detail, including radial loads, and combining individual systems into a combined loss formula. This work was performed by Ebasco and IBM on a 701-type computer, using the Kron method.

Useful byproduct of the interconnection of individual system loss formulas into a combined formula was the consequent availability of several types of loss formulas for the combined system, involving:

1. Generating plants, foreign interconnections and the scheduled interchange between each pair of systems.

2. Generating plants, foreign interconnections, and the total territorial load of each of the four systems.

3. Generating plants, foreign interconnections, and the excess or deficit of generation above or below load for each of the four systems.

4. Generating plants and foreign interconnections, based on a typical allocation of territorial load among the four systems. This type was used in the economic loading study.

A loss formula was also made available for each of the four individual systems involving generating plants, foreign interconnections, and internal system interconnections.

Loading schedules were made including certain stations as variables and also as operating with fixed loading and/or fixed unit price per kwhr generated. Transmission losses on frequent sales to one interconnection were handled by considering the interconnection as a negative source and using the system loss formula for determining losses with and without the sale. IBM cards and wiring panels permitted use of an accounting machine at Pine Bluff, Ark., for determining losses for typical hours, data being taken from the dispatcher's logs.

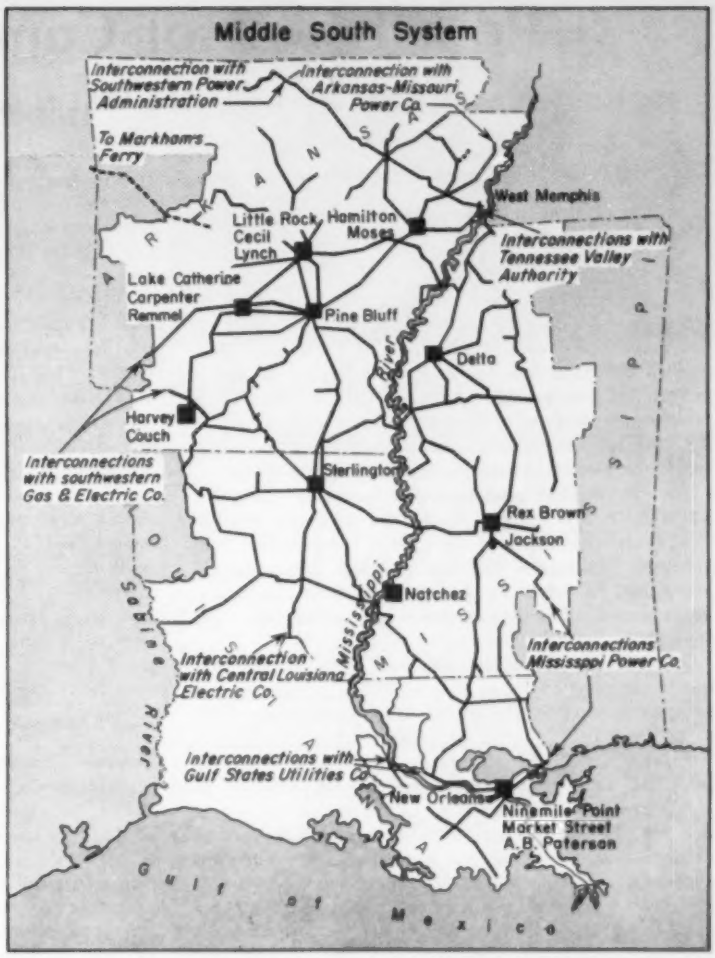
The problem of many interconnections on the Middle South System was simplified by the fact that interchange with all systems, except one, is normally zero. This fact permitted the neglect of such interconnections in the final loss and loading calculations.

Hydro . . . Hydro must be considered both as to its effect on the cost of power and as to its effect on losses from power delivered by the steam plants. Hydro's effect on cost may be neglected when hydroelectric power is either cheaper or more costly than power from any steam source considered. On the Middle South System peaking hydro is more and dumping hydro less expensive than steam.

The effect of hydro on losses can be determined only by making actual schedules. After study of losses with or without hydro, it was concluded that the effect of hydro losses on steam allocation was negligible. Most company-owned hydro is peaking hydro, this fact permitting its deduction from the peaks of the total system load in scheduling steam operation. Used or unused, SPA hydro must be paid for and consequently is deductible from the peaks of the total system load before scheduling steam operation.

Separate loss formulas for component systems accounted for variable growth on different sections of the

(*Continued on page* 171)



SYSTEM MAP of Middle South Utilities, Inc., shows principal power plants, and transmission lines and interconnections

Penalty Factor Computer Teams

Computer with incremental load slide rule enables AG&E to save $200,000 yearly on fuel bill

A. H. WILLENNAR, Chief, System Production Coordination Group, and
G. W. STAGG, Electrical Engineer, American Gas & Electric Service Corp, New York, N. Y.

A penalty factor computer in combination with an incremental load slide rule, operating today in the Central Production Coordination Office at Columbus, Ohio, enables the American Gas & Electric System to realize annual fuel cost savings amounting to $200,000. These savings are obtainable through accurate recognition of the effects of transmission losses in the assignment of generation on the AG&E System.

The incremental slide rule-penalty factor computer combination has afforded AG&E the following benefits:

1. It readily provides the power coordinator with necessary incremental fuel cost and loss data, thus enabling him to determine the most economic distribution of generation for any condition of system load and capacity.

2. It provides the coordinator with a visual picture of the incremental fuel cost characteristics of the various units on the AG&E System throughout their entire loading range.

3. This picture also enables the coordinator to foresee large and rapid changes in individual unit outputs. In many instances, the magnitudes of the desired individual unit changes are beyond the response capability of the particular units. Ability to anticipate such conditions enables the coordinator to (1) obtain minute-to-minute changes of generation in the most economical manner consistent with overall system regulation and unit response characteristics, and (2) assure that the optimum distribution of generation is restored as soon as possible.

4. The combination is useful in the advance determination of capacity to be operated during various periods of the daily load cycle. Schedules are prepared after evaluation of the various costs involved in operating individual units of system capacity and include such practical operating considerations as distribution of spinning reserve and local area protection. The proper selection of elements of system capacity to be placed on the line during different load periods is just as important to overall system fuel economy as the incremental loading of these units once they are in service.

5. From this combination, fuel costs and transmission losses can be obtained readily for use in the evaluation of various interconnection sales, purchases, and interchanges.

6. The combination is applicable to special studies in connection with either fuel costs or transmission losses, or a combination of both.

7. The incremental slide rule and penalty-factor computer are separate and independent units. This has greatly simplified design and construction and facilitated maintenance of each.

8. The combination will increase operating efficiency. The penalty factor alone will result directly in additional savings conservatively estimated at $75,000 a year by (1) providing a more accurate means of determining incremental loss data, and (2) eliminating the need for the tremendous number of computations previously required to include the effects of losses in the allocation of generation.

Penalty Factor Computer . . . The penalty factor computer is a calculating device providing the load coordinator with line loss penalty factors and incremental losses for various system operating conditions. It gives the transmission loss behavior of the system represented mathematically by a transmission loss formula. The computer consists of adjustable power units set to represent various plant loadings and interconnection flows, an adjustable network representing coefficients in the transmission loss formula, and a central penalty-factor and incremental-loss meter.

After power settings have been made on the computer for a particular condition of system load, the penalty factor for a given plant or interconnection is read on the central meter by pressing the key for that plant or interconnection. The computer performs the calculation instantaneously.

Computer Calibration . . . Calibration of the computer for operation entails setting the transmission-loss-formula coefficients on adjustable potentiometers. These coefficients, calculated by the engineering staff of the AG&E Service Corp with the aid of the network analyzer and digital computers, cover a specific period of operation based on the current construction program of new system facilities.

As such, the coefficients represent a particular system and must be revised periodically for major changes in the characteristics of that system, such as the addition of new transmission lines, generating plants, or a major change in the distribution of system load. Once the constants have been set, they remain unchanged for day-to-day operation. To keep the computer abreast of system growth and changes, however, new coefficients must be determined every four to six months.

Incremental Load Slide Rule . . . The penalty-factor computer was designed for use in conjunction with the already installed incremental load slide rule. This slide rule in the Columbus office consists of a logarithmic calibration scale, a movable strip for each generator unit, and movable fuel cost adjustment scales. The calibration scale, the incremental fuel cost rate, is graduated in mills per kwhr to a logarithmic scale.

Each movable strip, calibrated in Mw, indicates the relation between the incremental fuel rate and the output of each generator unit as determined from thermodynamic studies. Differences in fuel costs are accounted for by clamping the indicators with the top edge at the plant fuel costs on the fuel cost adjustment scales. Once these indicators have been clamped in position on this scale, which is graduated in cents per million Btu, the indicators and scales can be shifted up or down as a unit.

With Slide Rule

through recognition of transmission losses

A line loss penalty factor scale was incorporated in the design of this slide rule. These factors represent the adjustments which should be made to the generator strips to compensate for the effect of transmission losses in allocating generation. An adjustment is made by placing the top edge of each indicator at the appropriate penalty factor for each plant derived from the computer. For a desired total system generation, the slider is shifted, and individual generator outputs for optimum system economy are read directly from the individual generator strips.

This slide rule is a simple, accurate, flexible, and inexpensive device for comparing incremental fuel costs adjusted for the effect of losses between various generating units throughout the system.

In determining optimum economy loading schedules, a preliminary distribution of system generation among generator units in service is obtained (from a comparison of incremental fuel costs) by means of the incremental slide rule. This distribution is set into the computer, and penalty factors are read for different generating stations. The penalty factors are then set on the incremental slide rule, and a new generation schedule is obtained including the effects of transmission losses. When necessary, this step is repeated until a balance has been obtained between the computer and the slide rule.

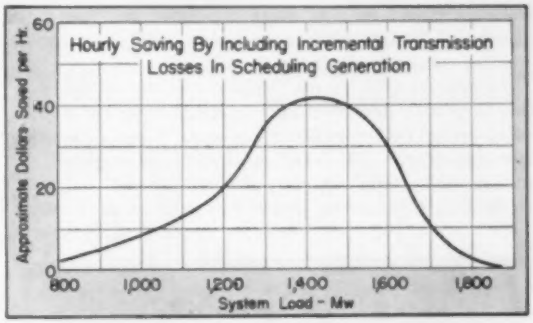
In actual operation, a complete economic distribution of generation has been obtained in two to three minutes. Subsequent minute-to-minute schedule changes, reflecting relatively minor increases or decreases in system load, are made in a much shorter time.

Coordinated Scheduling . . . Before preparation of the first coordinated generation schedule for the AG&E system in September, 1948, it was apparent that the sizable lengths of transmission line linkage between plants would make a proper evaluation of transmission line losses of major importance in arriving at the optimum distribution of generation. Accordingly, the estimated hour-to-hour loading of certain key power lines between plants, together with the incremental line loss characteristics of those lines, was used as a guide in setting up system schedules. At this time, the so-called line loss penalty factor came into use on the AG&E System.

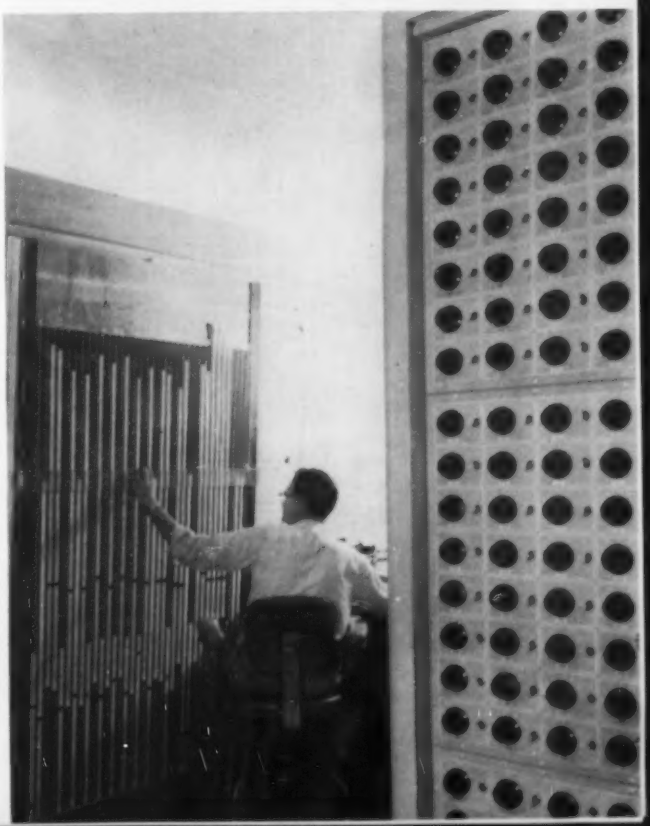
This penalty factor is the adjustment on the slide rule correcting the basic fuel cost of each plant to include the effect of transmission losses in scheduling generation. Complexity of the transmission network, however, made it impracticable to predict accurately the loading of individual transmission lines. The time limitations on setting up generation schedules also precluded consideration of all but a very few of the major tie line loadings.

Subsequently penalty factors were computed from transmission loss studies made on the ac network analyzer with a view to overcoming these difficulties. From these studies for certain basic conditions of system load and capacity sets of tables were prepared showing penalty factors for various plants under the specified conditions. Although this was a step forward in the evaluation of transmission

Penalty Factor Computer . . .



Produces These Savings When . . . Used With This Slide Rule

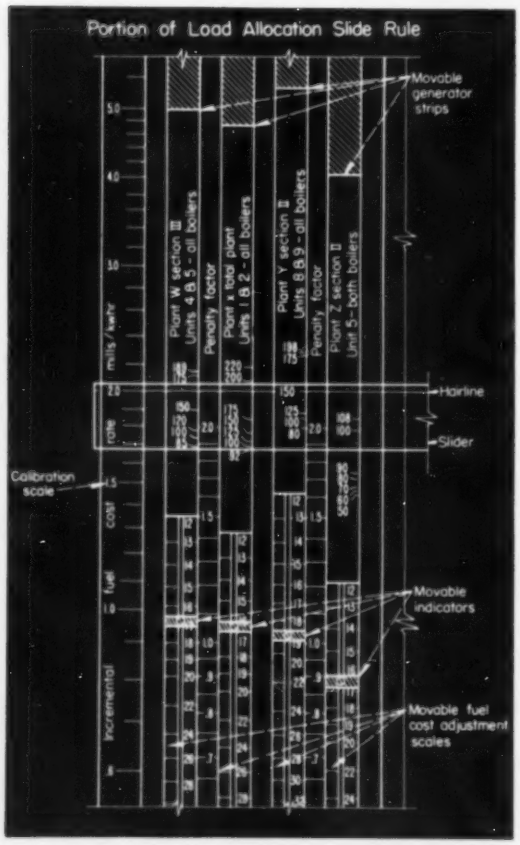


Combination Gives Optimum Loading Schedule

losses, experience has shown that the use of line loss tables or curves leads to inaccuracy and consequent loss of economies. It was found impracticable to prepare and physically impossible to use the numerous curves or tables required to cover the different combinations of system load, capacity, and generation in an average day's operation.

Need for Computer . . . In view of the numerous complex factors in an accurate evaluation of transmission losses on the AG&E System, the need for a computer was evident. Companies comprising the system provide electric service to almost 1,300,000 customers in a 46,000-sq-mile territory extending from Lake Michigan to the North Carolina state boundary. The area's population has been estimated at 4,755,000 living in more than 2,300 communities and the rural parts between them.

Six operating subsidiary companies of the AG&E System have been integrated into a single completely coordinated power system to serve this area. These companies own and operate 33 steam and hydro power generating stations with a total capability of 4,000,000 kw. But 95% of the system generating capacity in installed in 12 major plants, 11 of which are steam. Plants and load centers of the system are tied together by a network of 5,400 miles of 132 and 330-kv transmission lines.



SKETCH shows portion of incremental load slide rule used at Central Production Coordinating office, Columbus, Ohio

The AG&E System maintains one or more interconnections with 15 companies bordering its area, with whom energy may be exchanged on various contractual bases. During 1954, more than 19,600,000,000 kwhr were produced by the generating stations of this system, of which nearly 97% was generated by steam. The maximum 1-hr system peak demand for 1954 was 3,302,000 kw.

System Study . . . General Electric Co, the network analyzer staff at Purdue University, and the AG&E Service Corp jointly set out in 1950 to develop new methods of including the effect of transmission losses in the economic scheduling of generation. E. E. George had derived a general loss formula, expressing losses in terms of plant generation and a series of transmission loss coefficients, and J. B. Ward, H. Hale, and J. R. Eaton had developed methods greatly simplifying the determination of the transmission loss formula coefficients.

The accuracy of these formulas in their application to scheduling generation had not been evaluated up to this time, and no accurate method had been developed for coordinating incremental fuel costs and incremental transmission losses in a form applicable for scheduling of generation.

The group accomplished the following:

1. It developed a new and improved method of obtaining a transmission loss formula.

2. It successfully applied digital computers in the calculation of a transmission loss formula.

3. It evaluated the assumptions made in deriving a transmission loss formula when that formula was applied to the AG&E System to determine transmission losses.

4. It developed an exact and practical method of coordinating incremental fuel costs and incremental transmission losses.

5. It evaluated the errors introduced in optimum system operation by the assumptions involved in determining a transmission loss formula.

6. It evaluated the savings obtained in system operation by coordinating incremental fuel costs and incremental transmission losses.

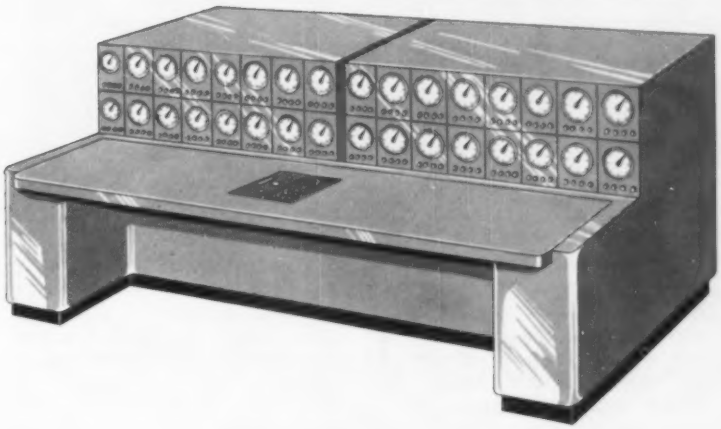
First two loss formulas were derived for a simplified representation of the AG&E system, one for a peak-load and the other for an off-peak-load condition. Data led to the conclusion that one formula calculated from an average operating condition could be used to calculate both total and incremental losses with reasonable accuracy for all the operating conditions. This conclusion was essential in determining whether a computer could be designed for use in load scheduling by the system power coordinator.

Other Findings . . . The study then established the exact method of coordinating incremental fuel costs and incremental transmission losses for optimum system fuel economy.

As part of this study, savings obtainable in system operation by including incremental transmission losses in the

(*Continued on page* 220)

West Penn Electric's Power System . . .



. . . Will be Dispatched by this Board

Automatic Dispatch Pays Off

West Penn developing computer for 1,750-mile transmission system with 11 big power stations, 2 interconnections, a 1954 peak load near 1,300 Mw

W. H. OSTERLE, West Penn Electric System and

E. L. HARDER, Westinghouse Electric Corp, Pittsburgh, Pa.

Construction is well under way today on West Penn Electric Co's computer, an investment for solving economic dispatch equations automatically, allowing for day-to-day changes in fuel cost and plant efficiency.

Development of the computer is the logical result of West Penn's long interest in the effect of transmission losses on its interconnected power system. The integrated electric system is composed of three principal operating companies, Monongahela Power Co, the Potomac Edison Co, and West Penn Power Co, which together encompass 29,100 sq miles in Maryland, Pennsylvania, West Virginia, Ohio, and Virginia and transmit power over some 1,750 circuit miles of line at 132 and 66 kv.

Power to this system comes from ten major coal-burning power stations varying in size from 39 to 457 Mw; from one hydro station of 52 Mw; and, from small steam and hydro stations. In addition, interconnections are maintained with the American Gas & Electric System and the Duquesne Light Co. Peak load for the system was just under 1,300 Mw in 1954.

Dispatching has been performed on the bus bar cost basis which hitherto has been quite satisfactory. But in 1948 the system developed its first loss formula, from which came changes in dispatching ideas and a realization that money could be saved by correcting for transmission losses. More loss formulas were developed in connection with network calculator studies, and from time to time long-hand calculations were made to show

the effect of picking up load at different stations having the same incremental cost. Thus the dispatcher was given some idea of system loading with allowance for transmission losses where there was a choice between stations with the same bus bar cost.

Equations Multiply . . . While economic dispatching equations were being developed, incremental cost data were supplied as straight-line segments with slope and intercept values given. This procedure contrasted with the usual manner in which this information was furnished to the dispatcher—in blocks of power to the nearest 0.1 mill per kwhr.

Getting power station incremental cost data in a more usable form led to investigation of the input-output data on which the incremental cost curves were based and to the development of uniform methods by all three companies in the West Penn Electric System. The effect of fuel quality, cooling water temperature, mills and pumps out of service, and other factors affecting the output and thermal efficiency of the station were studied. These studies led to the development of a number of simultaneous economic dispatch equations, the solution of which presented a problem.

The Computer . . . Development of a computer for solving these equations automatically was begun. Inputs to this computer will be set in on various dials, the two principal inputs being the station costs and the constants of the transmission network. Station costs will be set in the form of curves of incremental cost vs power being generated by the particular station or unit.

Production cost at the station can be considered as being composed of two parts—thermal efficiency and fuel cost. For the computer, the production cost consists of a cost for a particular condition of fuel, water temperature, etc., plus a multiplier which takes care of fuel variations, changes in water temperature, and any other factor that can be treated as a fixed multiplier. Consequently, base station cost curves to be set into the computer are effective and useful for perhaps a year or several years. Seasonal changes, such as cooling water temperatures, or irregular changes, such as fuel cost changes, can be provided for on a cost multiplier dial. Settings on the cost multiplier dial for the system will be provided monthly by the system cost committee.

Data-Handling Flexibility . . . Maximum flexibility in handling data for the various stations has been provided. Each station is divided into generator groups so that a particular group can be represented by five or fewer curves for the different conditions of operation of that group. For example, a group may consist of several machines so integrated by common steam facilities that the individual costs cannot be segregated.

Still a number of different cost curves are necessary to represent this group for the various combinations of equipment. These several cost curves are plugged into the computer as potentiometer cards, and selection of the several curves for a group is performed with a selector switch. To shift from one combination to another, the switch is turned to the curve representing the combination then in use.

Sometimes a generator group may consist of two or three entirely independent generating units either within the same station or separate. A number of curves can be provided for this type of group. Where a station has two duplicate units, the two curves selected could be for either unit alone or for both units in service. Where a station has three dissimilar units, all independent, one curve must represent all three operating and brought on in efficient economical manner with respect to each other. Besides this curve, three other curves would be needed to represent the condition prevailing when each of the other units is out of service.

Thus each generating station on the system is represented by one or more groups of curves, each group of curves representing a particular group of generators in all possible operating combinations. This technique also provides flexibility required for handling interrelated groups of units having common steam facilities but not separable into smaller subdivisions.

Within the computer, each generating group is represented by a servo mechanism. Stations requiring more than one generator group have also a totalizing servo to obtain the total power which feeds into that point of the transmission network. Each group has three setting pointers which can be used to set the lower limit, the upper limit, and the current dispatched to the station, respectively. The servo dial shows the correct dispatch which can be compared with the actual dispatch at any time.

System Characteristics . . . Another principal quantity to be fed into the computer is the transmission system characteristics. These are set in the form of "B" constants of the loss formula by adjustable potentiometers. For instance, for a system having 20 generating stations, there are 20 x 20, or 400 such settings. "B" constants are determined by ac calculating board study, followed by digital calculations. One of several methods of determining these constants is described by W. R. Brownlee on p. 109.

Computer Operation . . . In using the computer the operator selects curves corresponding to the combinations of units in service. He sets the setting pointer for the lower limit to correspond to limits required for area protection or for minimum load on the units. Upper limits are set to correspond to the maximum power permissible on the various generators or groups of generators. When any unit is to be operated on a block, the operator sets the switch for that unit to the "fixed" position.

The computer is equipped with tie-line units so that the operator can set the flow on those lines directly. Tie-line switches are also set in the fixed position as tie lines do not have cost curves and are dispatched as fixed generating units. Non-conforming loads, if any, are treated as negative generators. Suitable cost settings are placed on the cost multiplier dials of any hydro stations involved.

Hydro Units . . . Frequently hydro units must be operated so that a certain amount of water or a certain amount of kwhr is utilized in a prescribed period, such as a day or a week. This can be done economically by assigning an incremental cost to the power at the station and dispatching it as prescribed by the computer. This requires assignment of the proper cost so that the desired amount of water or number of kwhr will be used during the prescribed period. The proper cost can be determined readily by experience and can be corrected towards the end of the period when

(*Continued on page* 220)

MASTER STATION CONSOLE with power switches it at left, and at right the data memory devices for five turbines

Load Scheduling Goes Automatic

Kansas City Power & Light expects year's fuel savings to pay for automation of data collection, computing, execution of system's generating schedules

D. H. CAMERON, Kansas City Power & Light Co, Kansas City, Mo.
and
W. S. BURT, General Electric Co, Lynn, Mass.

The new automatic dispatching system of the Kansas City Power & Light Company will eliminate data collection and makes computing and execution of generation schedules automatic. In the system dispatcher's office, power production allocation has been reduced to adding and removing generating units from the line. The only other routine duty of that office is the periodic monitoring of the system for assurance that automatic operation is functioning properly.

This prototype system for automatic dispatching of 12 steam turbines distributed over three stations was designed to provide annual fuel savings in the order of its purchase price. It was also designed to afford savings in both operating manhours and communication facilities. Considerable operating experience will be required before a detailed evaluation of these savings can be realized.

Operating power systems in a manner yielding a maximum return on investment is a project so complex today that system operators cannot analyze and act upon all pertinent data. Operators using manual procedures consider first the most important factors and extend their attention to as many other factors, in order of decreasing importance, as time and manpower permit.

Data Reduction Problem . . . One step toward improved system operation is the increased use of telemetering to afford additional data on system conditions to operating personnel. When data exceed the operator's ability to digest and act upon them, data reduction techniques, or computers for analyzing and presenting data in a more usable form, become a necessity.

Increasing use of centralized computers signifies a trend today toward a rapidly mounting investment in telemetering and communication facilities essential to optimum utilization of the central computing facility. Many companies today find provision of additional com-

(*Continued on page* 126)

Automatic System Schedules Load Among 12 Machines

(*Continued from page* 125)

munication channels a serious difficulty. The KCP&L dispatching system designers had this exigency in mind when they incorporated all data-handling functions in the control system itself.

The new automatic dispatching system's arrangement has the appearance of a business organization chart. Various levels of decreasing authority are associated with the following:

1. The overall interconnected system
2. The individual operating areas.
3. The station in each operating area
4. The machines in each station.

To reduce communication and routine supervision, all data pertinent to a part of the power system are inserted in the equipment at the location itself. The response to a change in the master signal defines the capability of the overall power system as determined by the sum of all economic data and practical limitations inserted into the dispatching system at all locations.

An important step in the solution of the data-handling problem is the use of an economic quantity, incremental cost, instead of the commonly used total generation as the principal variable in the computing control system.

When the entire economic and practical capability of the power system has been defined and controlled by one master signal, the master signal is continually adjusted to satisfy contractual and practical requirements of power flow over foreign ties, or to hold frequency and time when the control system is isolated, thereby achieving complete automation.

Consoles . . . The master area and dispatching consoles are in the system dispatcher's office. In addition to adjustments common to all load frequency control master controllers, the master area console continuously indicates cost in mills per kwhr of the last increment of power delivered to the area load. The dispatching console indicates the penalty factor settings determining the incremental bus cost at each of the three stations.

MASTER CONSOLE gives cost of last increment of power delivered to load, dispatching console penalty factor settings

Each turbine in the system, when on control, delivers all increments of power available at a cost up to the prevailing bus cost specified by the dispatching system. Changes in station incremental cost resulting from occasional changes in turbine data or in capability from adding or removing turbines are automatically compensated for by reallocating load among all machines in the power system.

Studies . . . Primary incentive for the first system study leading to installation of the KCP&L automatic system was correction of an arc furnace load producing 25-Mw, tie-line swings at unpredictable intervals. Studies of governor and valve gear characteristics had previously established the necessity of linear and predictable response in all elements of the regulating loop, which consisted of telemetering, supplementary control equipment, speed sensing element, and turbine valve mechanism.

Field tests on an incrementally regulated machine in service and analytical studies of system stability with automatic control also pointed to this solution. Use of "control selsyn" techniques for load frequency control equipment developed features important in establishing the final equipment. Most salient of these are:

1. Fast response—100% of capacity per min on all machines on control was selected as a maximum correction rate.
2. Synchronous and proportional changes in the position of the speed level mechanism of all turbines is obtained, regardless of synchronizing motor characteristics.
3. The control signal received at a particular generating station may be resolved to within 1/10 of 1% or better. This feature was later to become of primary importance in the development of economic loading.

These features are required for a control system to divide a sudden load change accurately among numerous turbines. Such division among controlled machines by means of the selsyn system is similar to load division by speed governor action on an isolated system.

Economic Loading . . . When a satisfactory solution of the area regulating problem had been achieved, KCP&L engineers sought to incorporate automatic economic loading into the control system. Guiding principles and considerations influencing the design of the system were the following:

1. The KCP&L operating group was scheduling 12 turbines in three stations on an equivalent plant basis, using incremental cost data.
2. The control selsyn technique provided a long-scale and extremely accurate resolution of the control signal.
3. The economic solution and the resulting equipment design should be directly applicable to any power system.

another TRANSFORMER DEVELOPMENT from General Electric

Unretouched photograph shows paper-and-cotton insulated wire (left) and the new Formex wire (right)

Tough, thin-skinned FORMEX* wire

now replacing paper and cotton in G-E transformers

Your General Electric transformers will be more reliable—yet smaller and easier to handle—because of a new use for a very remarkable film insulation.

Round Formex wire was a sensation when it was first used on General Electric Tri/Clad* motors. For the first time it made possible insulation that was a strong, integral part of the wire—not a bulky, wrap-around covering.

Formex wire has now been successfully adapted to the *rectangular* wire used in transformers. Application is made possible by a coating method developed by G.E. By this method, the insulation is spread evenly not only on the flat surfaces of the wire, but also on the edges. Once applied, the impulse strength of Formex wire is phenomenal; three mils thickness of the film insulation has *twice* the impulse strength of six mils of ordinary paper and cotton.

Already being used in many G-E power and distribution transformers, Formex wire in combination with improved core steel makes possible reductions up to 10 percent in transformer size and weight, while actually increasing reliability. To see how Formex wire is giving you better transformers, please turn the page.

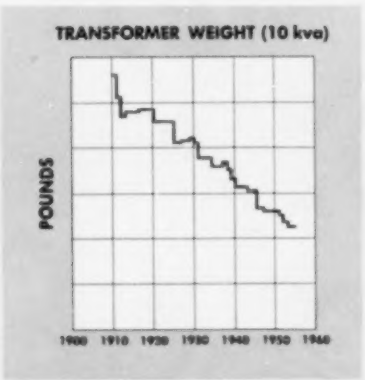
*Reg. trademark of General Electric Company

GENERAL ELECTRIC

FORMEX WIRE IN G-E POWER TRANSFORMERS MEANS SAVINGS IN INSTALLATION TIME AND EXPENSE.

Formex* wire cuts transformer weight

8 SUCCESSIVE COATS of the film insulation are applied and each is individually baked on. To assure quality, G.E. manufactures its own wire.



LIGHTER TRANSFORMERS — Since 1910, G.E.'s 10 kva model has been cut to 230 lbs. Formex wire means further reductions.

WINDING FORMEX WIRE for a distribution transformer. Notice uniform coil structure.

*Reg. trademark of General Electric Company

FORMEX WIRE HELPS MAKE G-E DISTRIBUTION TRANSFORMERS EASIER TO HANDLE.

up to 10%—yet increases reliability

The use of Formex wire and improved core steel makes General Electric power and distribution transformers up to 10 percent smaller and lighter and therefore easier for you to handle and install. This relatively large reduction in size and weight results from the snowball effect that savings in winding space have on total size and weight. For example, the use of Formex wire helps to reduce the size of the coil structure. This in turn permits a smaller core for the same performance characteristics. To hold the core-and-coil assembly, a smaller tank and less oil are required.

Not only will your new G-E transformers be lighter and easier to handle, but they will also be more reliable because of the durability of Formex wire. Up to eight separate coats are given to each strand of wire. The resulting insulation is so rugged that you can twist a piece of the wire many times without cracking or damaging it.

Formex wire is now used in certain distribution transformer ratings 50 kva and below. In many oil-immersed power transformers it is used on windings up to 25 kv. As rapidly as facilities permit, the use of Formex wire will be extended to other ratings, in G.E's continuing program of transformer research and improvement.

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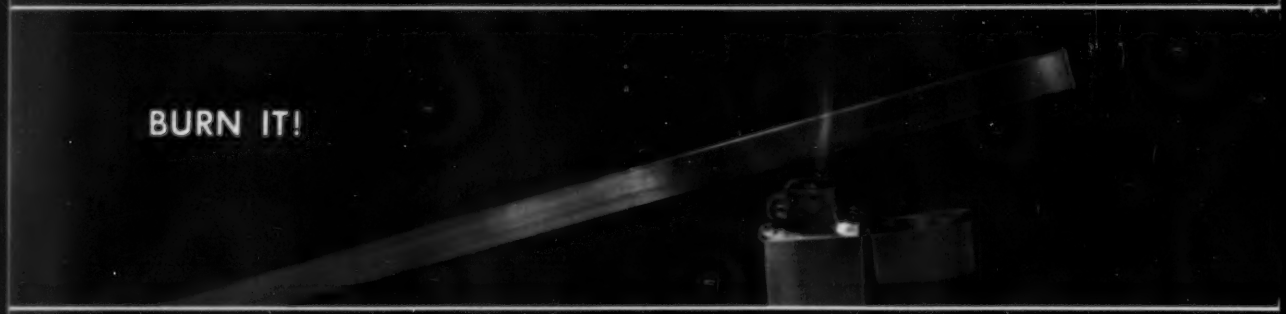
GENERAL ELECTRIC



FORMEX has amazing strength!

LET ME TEST IT!

General Electric Co., Section 431-19
Schenectady 5, New York

I'd like to see a sample of rectangular Formex wire. Send it to me at this address:

Name:_____

Address:_____

City_____ State_____

Test it yourself! General Electric will be glad to send you a sample of the new rectangular Formex wire to test under your own conditions. Once you've tried the experiments demonstrated above, you will understand why the new Formex wire improves transformer reliability. For your sample, mail the coupon today. General Electric Co., Schenectady 5, New York.

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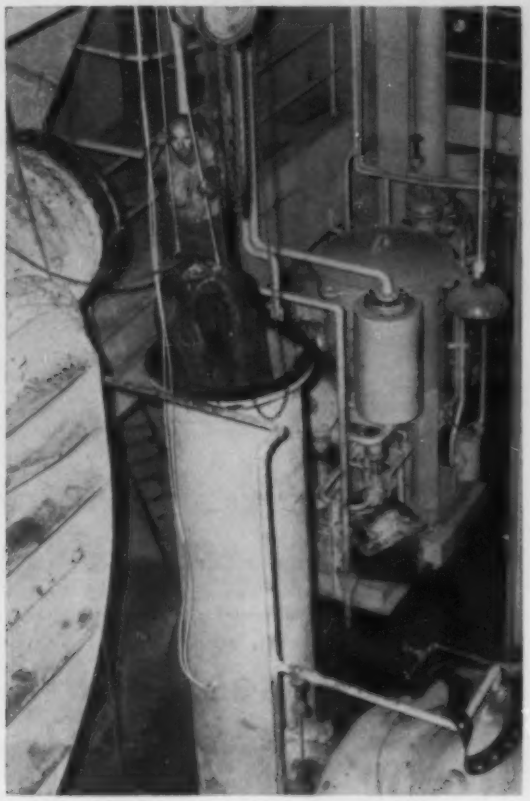
Neoprene-coated nylon ballon is used . . .



to plug a condenser pipe line to . . .

Eliminate Station Shutdown for Pipe Changes

F. C. KHARE, Results Engineer, South Carolina Electric & Gas Co, Charleston, S. C.

A special balloon was used by South Carolina Electric & Gas Co to plug a 30-in. circulating water pipe to one of three condensers at Plant Hagood during piping modifications. The plug eliminated the need to de-water the large intake and discharge tunnels and permitted continued operation of the other two units during the six-day job.

Plant Hagood, located near the sea coast, uses river water for condensing. To provide a positive head on the suction side of the circulating pumps, the intake and discharge piping as well as the flange to be modified are located below low-tide level.

Time required for the modification was estimated at five days plus several more days if the tunnels had to be blocked and cleared. Several types of folding plugs for the 30-in. pipe were considered to obviate shutdown.

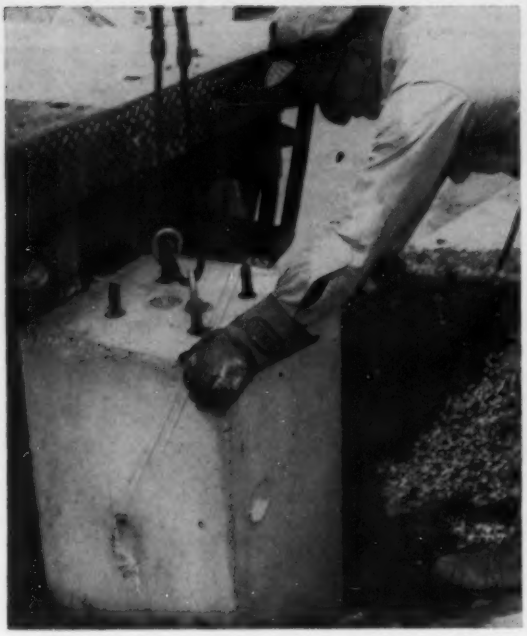
An inflatable rubber balloon was thought to be most desirable because the folding plug had to be removed through a new butterfly valve that was to be installed. However, inquiry revealed that a 30-in. balloon plug was not available.

Pertinent data were supplied to a rubber manufacturer who fabricated a neoprene-coated nylon balloon, 30-in. in diam and 5-ft long, that operates at 15 psi air pressure. It is equipped with handling rings, nylon ropes, and necessary air connections.

At the start of the modification a 12-ft vertical section of piping was opened at top, above the water level. With weights attached the deflated balloon was lowered through the pipe and into position below the floor flange. Counterweights held the plug below water level until it engaged with the pipe walls during inflation.

Effectiveness of the plug, which was designed using assumed conditions for the pipe and balloon material, was checked for leakage through a complete tide change. After the seal proved satisfactory, the 12-ft vertical section of pipe was removed and air connections to balloon lowered through the pipe. New section of pipe with butterfly valve was then installed, with air hose through it.

Because the new butterfly valve was located just above low-tide level, seal removal had to wait for low tide. At that time, the balloon was deflated and removed through the valve. Then the valve was closed, and the piping modification was completed in a normal manner.



ANCHOR BOLTS are used in lowering foundation. Unit can be installed in about 20 min under ideal working conditions

LIGHTING CABLE is easily installed through holes in precast foundation. Holes are installed on sides of the foundation

Precast Bases Cut Street-Lighting Costs

F. T. HAUSLE, Distribution Design Engineer, Long Island Lighting Co, Garden City, N. Y.

Long Island Lighting Co has standardized on precast concrete foundation for metallic street-light posts because they:

1. Cut labor and material costs.
2. Cause less public inconvenience.
3. Provide a more stable foundation than field poured footings.
4. And eliminate material storage problems.

The foundations measure 17 x 17 x 40 in. for 10 to 25-ft posts without provisions for transformer or ballast installations in the base and 20 x 20 x 40 in. for 25- to 30-ft posts with transformer bases. They are cast with mounting bolts and cable holes from a mix of 1 part Portland cement, 2 part sand, and 4 parts gravel.

Foundations are set in hole, excavated by either hand or pole digger, so that the top is about an in. above finished grade. After the post is bolted in place, the foundation is leveled, lower half of the hole is backfilled, cables are installed, and the rest of the hole is backfilled.

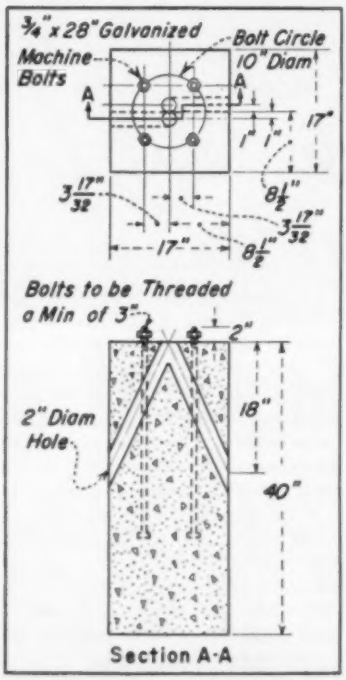
A complete 10-ft street light post and foundation can be installed in 20 min under ideal conditions. Normally, 30 min per post are required on large scale jobs of 20 or more units.

Savings of $10.50 per unit have been realized in some installations, thus exceeding the estimated saving of $4.00 per unit. This method rarely interferes with the public, thus public relations improve.

Tests, following IES recommendations for steel and aluminum posts indicate that the precast foundations are adequate for the load they carry. No shifting of the foundations occurred when the prescribed 500-lb horizontal pull was applied. In fact, most footings held beyond the prescribed limits of the 25 and 30-ft steel poles used in the tests. These tests were made on foundations for all sizes of posts from the 10 ft residential type post to the 30-ft highway type.

Precast foundations are more stable than field poured bases because they are all cast to the same weight, size, and shape. This eliminates differences previously experienced in the field poured bases.

Material storage problems are eliminated because all foundations equipped with anchor bolts are delivered to the job site by the manufacturer.



CONCRETE foundations eliminate storage problems and pouring difficulties

(*More How To on page* 136)

G.E. designs light, compact, 5 KV current transformer with high resistance to corrosion

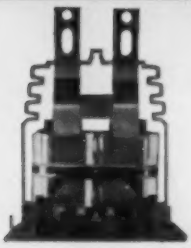
One third smaller and lighter, the new butyl-molded, outdoor, Type JKW-3 transformer is easier to install and maintain.

Almost completely corrosion-proof, this new General Electric current transformer is the first butyl-molded transformer designed for 5000-volt outdoor application. This revolutionary design has virtually eliminated maintenance. **CORROSION-RESISTANT** materials are used in all exposed metal parts. The case and primary bushing are butyl rubber. The butyl also serves as insulation and as an important factor in the new Type JKW-3's high mechanical strength.

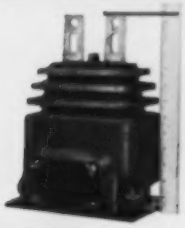
EASIER TO INSTALL, this new G-E current transformer can be mounted in any position for bottom-, side-, or top-connected installations. The lightweight and smaller size facilitates installation and handling.

ACCURACY CLASSIFICATION of the Type JKW-3 transformer is 0.3 at burdens: B-0.1 to B-2.0. Ratings are from 10 to 800 amperes.

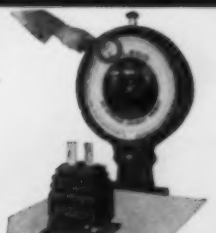
FOR MORE INFORMATION, contact your nearest G-E Apparatus representative, or write for Bulletin GEC-1222 to: Section 604-40, General Electric, Schenectady 5, N. Y.



1 BUTYL-MOLDED



2 COMPACT
only 12¾ in. high



3 LIGHTWEIGHT
only 42 lbs.

GENERAL ELECTRIC

NEW I-55 watthour meter will satisfy your needs—present or future—for a quality meter with an extended load range.

THESE 30 APPLIANCES SYMBOLIZE THE CAUSE FOR INCREASING RESIDENTIAL LOADS, WHICH WILL DOUBLE IN THE NEXT TEN YEARS

NEW General Electric I-55 Watthour Meter Designed to Measure Increasing Loads

NEW METER FEATURES STRAIGHT LINE ACCURACY UP TO 100 AMPS

Combining all of the proven qualities of the I-50 meter family with straight-line accuracy up to 100 amps, General Electric's new I-55 watthour meter will meet your requirements for a quality meter.

INCREASING RESIDENTIAL LOADS, predicted to double within the next ten years, necessitate a new meter like the I-55, capable of measuring loads up to 100 amps. This newest addition to General Electric's I-50 meter family has been designed to measure the increasing loads of the home of today or of the all-electric home of the future.

ALL COST-SAVING FEATURES of the proven I-50 meter family have been incorporated into this new extended-range meter. Magnetic suspension, unique retarding system, rigid unit construction, and easier-to-read pointer and cyclometer registers are but a few of the original I-50 qualities which are present in the new General Electric I-55 meter.

FOR MORE INFORMATION on the new I-55 meter, write for bulletin GEA-6071 to: Section 621-2, General Electric Company, Schenectady 5, N. Y.

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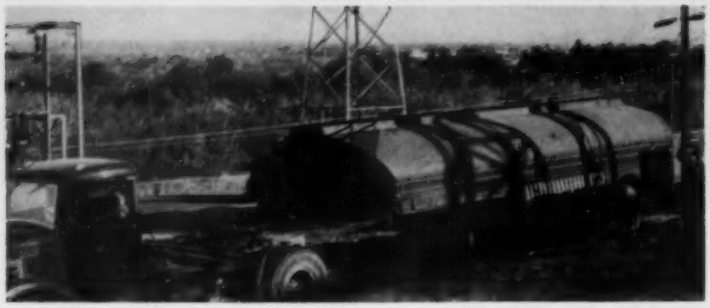
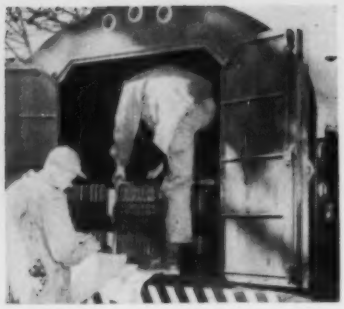


OIL TANK TRAILER is spotted by a truck-tractor at the most convenient location in the substation. Oil and electrical connections are made, and work commences



FILTER PAPER is inserted into press, located in rear compartment of tanker

Tanker Filters Oil, Cuts Breaker Overhauling Time 60%

A special tanker for hauling and filtering insulating oil of substation equipment has been developed by Niagara Mohawk Power Corp. Use of the trailer reduces overhauling time for a large breaker more than 60% and eliminates need for numerous oil drums to store oil when working on equipment. Moreover, fixed tank installations at large stations with their extensive piping and maintenance problems are eliminated.

The tanker has two separate tanks, each with a capcity of 2,500 gal. A built-in filter press, located in the rear compartment, can filter 100 gpm. Other compartments contain electrical equipment for drying paper, a pump, 1½-in. neoprene hose, fire extinguishers, tools, etc.

Piping and valves are arranged so oil can be pumped into, out of, or between tanks with or without the filter press connected in series. An electric system in the trailer, including explosion-proof lights in all compartments for night jobs, plugs into a 240-v supply at the substation.

Using the trailer a maintenance crew can overhaul a large breaker in one day that previously required three days. Men like the trailer because it makes the job cleaner and easier.

Thermostatic Control Saves Transformer Cooling Water

LEO K. HARRIS, Substation Department, Detroit Edison Co, Detroit, Mich.

Modulating cooling water flow to six transformers, rated 7.5 and 8.5 Mw, with thermostatically controlled regulators reduced water costs over 50%. Detroit Edison Co's annual water consumption was cut from 11.2 million cu ft to 4.9 million cu ft with an accompanying decrease in the water bill from $8,633 to $3,918. Cost of installing the six regulators was about $1,650, or one third of the annual savings.

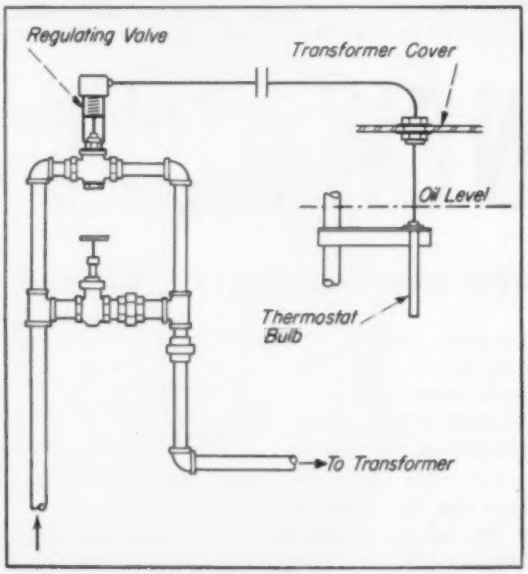
The regulators replaced a procedure in which roving operators adjusted water flow at unattended stations to meet the peak-load requirements. This practice resulted in excess use of water during light-load periods.

To eliminate waste, several types of control equipment actuated by top-oil temperature were considered. Trial installations showed a vapor-pressure type regulator used less water and appeared more reliable.

The regulator fails safe. Any rupture of the temperature sensing bulb, operating bellows, or interconnecting tube opens the valve fully.

The transformers require about 35 gpm of water each when fully loaded. It is desirable to maintain as small a temperature differential as possible between the cracking of the valve and the 35-gpm flow. This differential can be decreased somewhat by oversizing the valve so a 1½-in. valve is used instead of a 1¼-in. size, which would otherwise have adequate capacity.

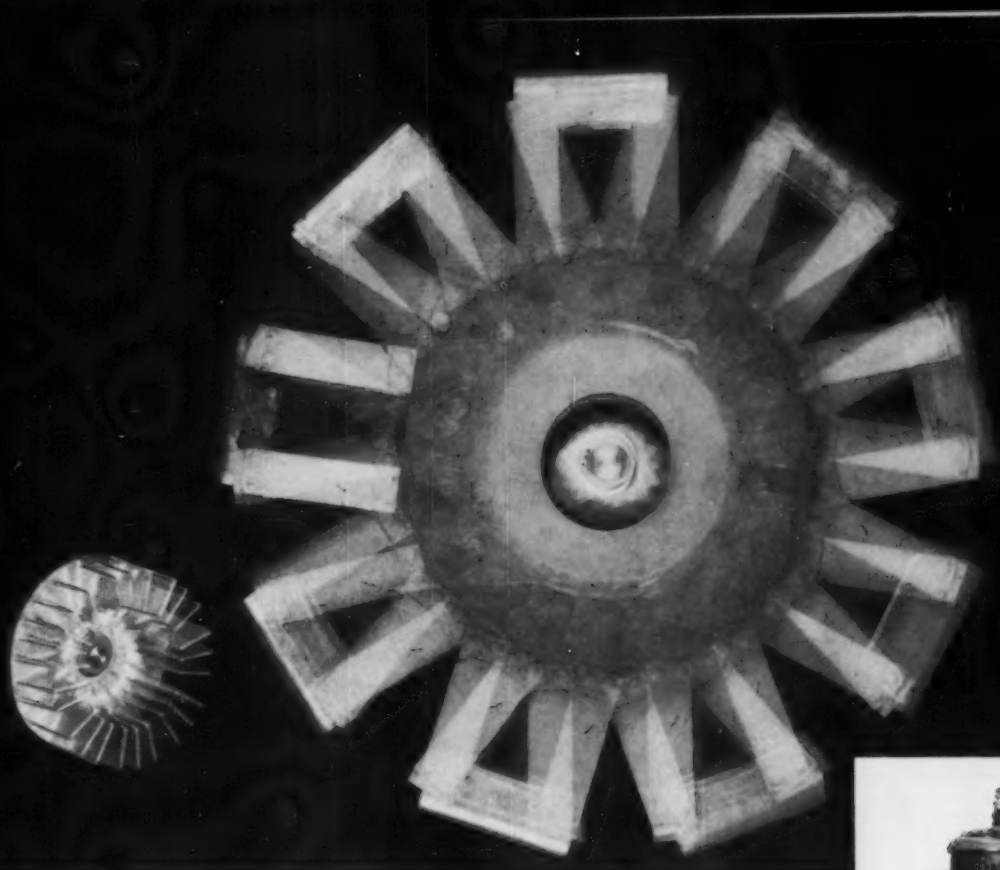
Manually operated by-pass valves permit hand regulation if the thermostatic control fails or requires service.



REGULATOR VALVE connected in water line coordinates consumption with loading and cuts 50% off of water bill. Forty more installations are planned for unattended subs

Plans call for installing water regulating equipment on all 40 water-cooled transformers in unattended substations as a result of experience with the initial installations, suggested by Robert Ashley, substation operator.

(*More How To on page* 140)



STROBOSCOPIC PHOTO of spinning paddle wheel (left) and rotating tap changer on G-E ML32 regulator.

DOES YOUR SUPPLEMENTARY REGULATOR HAVE

"Bounce-free" switch action for lower maintenance cost

Here's *another* important General Electric voltage regulator feature that appreciably lengthens contact life—reduces maintenance expense. The secret: "Bounce-free" Opti-Life switching, which makes the contacts glide into the next tap position.

See that little paddle wheel in the photo, at the left of the switch? It acts as a speed-controller to minimize erosion as the contacts part. You get an optimum speed . . . not too fast, not too slow. Also, entry into the next position is smooth, positive, with no life-reducing bounce. This little Opti-Life impeller has helped extend contact life to over *five times what it was ten years ago!* It's an exclusive feature of G.E.'s ML32 single-phase step voltage regulator for supplementary service.

12 more features, many just introduced into the 1955 ML32 feeder voltage regulators, mean greater accuracy, longer life, superior service. They add up to the most advanced supplementary regulator available today. General Electric Company, Schenectady 5, New York. 423-6

ONLY THE ML32 GIVES YOU ALL THESE FEATURES

Greater Accuracy

Class 1 Control Accuracy
Control Dial Locking
Control Test Rheostat
Rheostats For LDC Adjustments

Longer Life

Opti-Life Tap Switching
One-Piece Cover Band
Super Melaglyp Paint
Nitrile Rubber Gaskets
Electrostatic Shielding

Superior Service

Flat Upper VRR Contacts
Up To 120-Sec. Time Delay
Handy Meter Shelf
Internal By-Pass Protection

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Safety Check for Industrial Batteries

Simple suggestions, when working around storage batteries, that will be helpful to prevent injuries to personnel and damage to batteries and related equipment

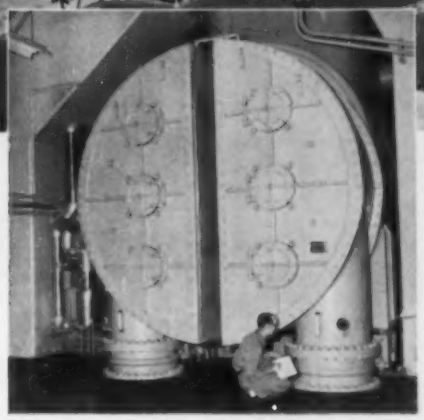
K. A. VAUGHAN, Manager-Field Engineering, Gould-National Batteries, Inc., Trenton, N.J.

WHAT TO DO . . .	. . . AND WHY
Wear rubber apron, gloves, boots, and goggles when handling, checking, filling, charging, or repairing batteries.	To protect yourself against accidental spillage of electrolyte, a mixture of sulphuric acid and water.
Use a flashlight or provide adequate permanent lights for inspection. Keep open flames away from storage batteries. Do not check electrolyte level with a match or lighter.	The least battery damage that results if a flame causes an explosion is a cracked or fragmented battery cover. The worst condition occurs when electrolyte sprays on a worker.
Have water available for use when electrolyte has been splashed on worker's skin or clothing. Exercise extreme care in flushing electrolyte from the eye. Use plain water only and report to first aid immediately.	Volumes of water applied quickly, continuously and copiously will prevent serious injury to the skin. Quick medical attention is necessary to assure proper care and treatment.
Apply strong neutralizer such as baking soda when acid is spilled on the floor and clean up promptly.	Baking soda will neutralize the acid and make it safe to clean or flush from the floor.
Take proper care in melting the sealing compound. Avoid puncturing the hard surface of partially melted compound with a screw driver or other sharp tool. Do not allow compound to ignite by too rapid heating.	The hot liquid may squirt up and burn hands, face or body of a workman. If it catches fire it creates the hazard of an open flame. Burning consumes oil in the compound and impairs its useful characteristics.
Remove vent caps from nearby cells and blow out each cell to remove gas when preparing to reassemble a repaired cell into the battery. Cover the vent holes with layers of damp cloth before using lead burning equipment on the intercell connectors. Use dark glasses to protect eyes.	Either lead burning equipment or an acetylene torch is normally used and both are hot enough to cause hydrogen to explode, if present. This is a real hazard and should be recognized at all times. Harmful light rays and molten metal will have harmful effect upon the workers eyes.
Open the power supply switch when changing or repairing plugs or receptacles that are connected to the charging equipment.	A short circuit and arcing will be prevented. A short circuit may injure a workman and arcing may cause explosion and fire.
Open or "break" the battery circuit before removing the terminal lugs from the receptacle when repairing a damaged or dirty electric plug or receptacle connected to a battery. The leads which terminate in the receptacle are "hot" with the total battery voltage.	If the terminal lugs are touched together a short circuit or arcing will occur. Current carried may reach 10,000 amp and may exceed the capacity of the leads. The short-circuit rate will equal three times the one-minute discharge rate of the battery.
Wear protective clothing and goggles whenever it is necessary to mix acid and water. Always add acid to water and stir constantly to mix well. Always store acid in lead or glass containers.	If water is added to acid it will not mix readily and the acid will splash due to the great difference in the specific gravity of the two liquids. Effect of splashed acid is dangerous.
Always lift batteries with mechanical equipment and then move them horizontally. Make sure that hoist hooks, spreader bars and other tools are amply strong and properly installed. Cover top of battery with rubber mat or sheet of other insulation.	Batteries are a heavy concentrated load and might easily cause painful strains or injury to handlers' feet or hands. Batteries, too, may be seriously damaged or electrolyte spilled, if the battery is dropped. Insulation prevents short circuits from chains or cables falling on battery.
Make sure that charging plugs and receptacles are properly locked and all other connections tight.	A loose connection may mean sparking or even arcing with attendant danger of gas explosion.
Disconnect battery from truck when doing maintenance and repair work on the motor or electrical system.	Current may cause arcing or short circuit with its attendant damage to equipment or injury to workers.
Never lay metal tools such as wrenches on top of an open battery.	Sparking and short circuiting will occur and the battery will quickly be discharged.
Enclose all bare wires and bus bars in the battery room by wire guards, guard rail or other means for isolation.	Any open high-current transmission equipment is a possible hazard to workmen and plant.
When batteries are scrapped at the end of useful life, drain electrolyte and flush out cells with water.	An old battery may have enough residual voltage left to cause a spark if filled with electrolyte when sold for junk.

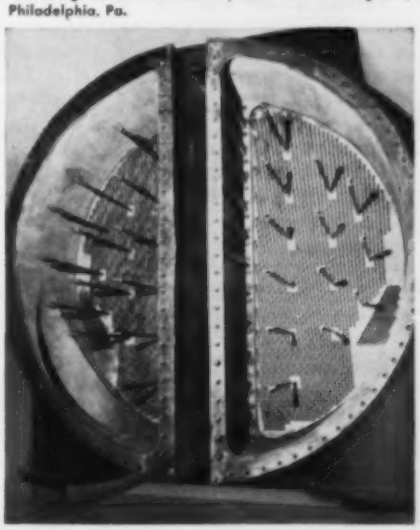
A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.

REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are $\frac{7}{8}$" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

Man-Lift Speeds Stringing of Crane's Trolley Line

Installation of a feeder trolley line for a gantry crane atop the Corps of Engineers' Chief Joseph Dam was made on schedule with the aid of a mobile personnel lift and crane. Use of the mobile unit averted a slow-down of work on the dam's intake structure that was dependent upon operation of the 50-ton gantry crane. The trolley line was completed in less than one week.

The mobile lift adequately and safely met the requirements of the trolley line installation. Specifications called for a 2,200-ft, three-wire, trolley feeder line to be installed 30 ft high on standards at the edge of the intake structure. The standards also support mercury vapor lights which project several feet below the trolley line supports. Use of the standard type of elevating scaffolding was impossible. Because of a sheer drop of almost 200 ft, safety regulations ruled out the usual type of ladders.

The mobile lift and crane mounts on a 1½-ton truck. It has an insulated glass-fiber personnel cage which can be lifted to any position by a jointed mast actuated by two hydraulic two-way cylinders. The model has a maximum working height of about 35 ft and can rotate on its platform through a full circle continuously. The machine's movements are controlled either from the operator's cage or from a second set of controls at the base of the unit.

TROLLEY LINE, 2,200-ft long, was put up in less than a week when contractor called upon a personnel lift for speed

Pushing Pipe Under Street Reduces Installation Time

JOHN R. KELLEY, Engineer of Underground Distribution, Department of Water & Power, Los Angeles, Calif.

Pushing a large steel pipe under the street at a busy intersection allowed the Department of Water and Power to install a 34.5-kv cable section without impeding traffic at a major boulevard. About 100 ft of 36-in. steel pipe was placed under the street in 36 hours. The job would have required about 120 hours if done by open-trench construction.

In making the installation, an auger with a bite slightly smaller than the external diameter of the pipe dug the hole. A hydraulic ram of 30-ton capacity forced the pipe in after the auger. The pipe was worked in 10-ft lengths, new sections being welded on as the work progressed. The installation was handled by Pacific Coast Boring Co, Los Angeles.

The pipe provides space for eight runs of 5-in. fibre conduit and two of 3-in. Two of the 5-in. ducts carry 34.5-kv circuits, each consisting of 3-conductor, 1,500-MCM, paper-insulated, lead-covered cables, the remaining six ducts are spares. The two 3-in. conduits enclose control cables for signalling and temperature indication. Concrete spacers placed 4 ft apart support the 10 fibre ducts.

(*More How To on page* 143)

LARGE STEEL PIPE was rammed hydraulically through a hole augered under street. Time was saved and traffic flowed on

CASE STUDY

150,000 RECORDS

handled faster • more efficiently • at lower cost

ROCHESTER GAS & ELECTRIC CORP. SOLVES CREDIT-HISTORY RECORD PROBLEM WITH

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Super Elevator Files

THE PROBLEM: Former equipment spread work too far . . . made operators waste time walking, getting up and down, restoring files after each use . . . couldn't be expanded for increased volume within space available.

THE SOLUTION: Three Diebold Super Elevator Files, replacing approximately 2,000 slide visible files, provided needed expansion and enabled credit department to release 342 sq. ft. (45%) for other use . . . saved 43% in time . . . eliminated 26% of operations, 55% of walking . . . improved working conditions.

The case history of this motorized Super Elevator File installation is full of usable ideas for everyone working with mass-record systems. It shows how bringing records to operators' finger-tips by touching a button pays dividends . . . big dividends. Send for your copy today.

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Please send a copy of Rochester Gas case history and full information on Super Elevator Files for our _____ records.

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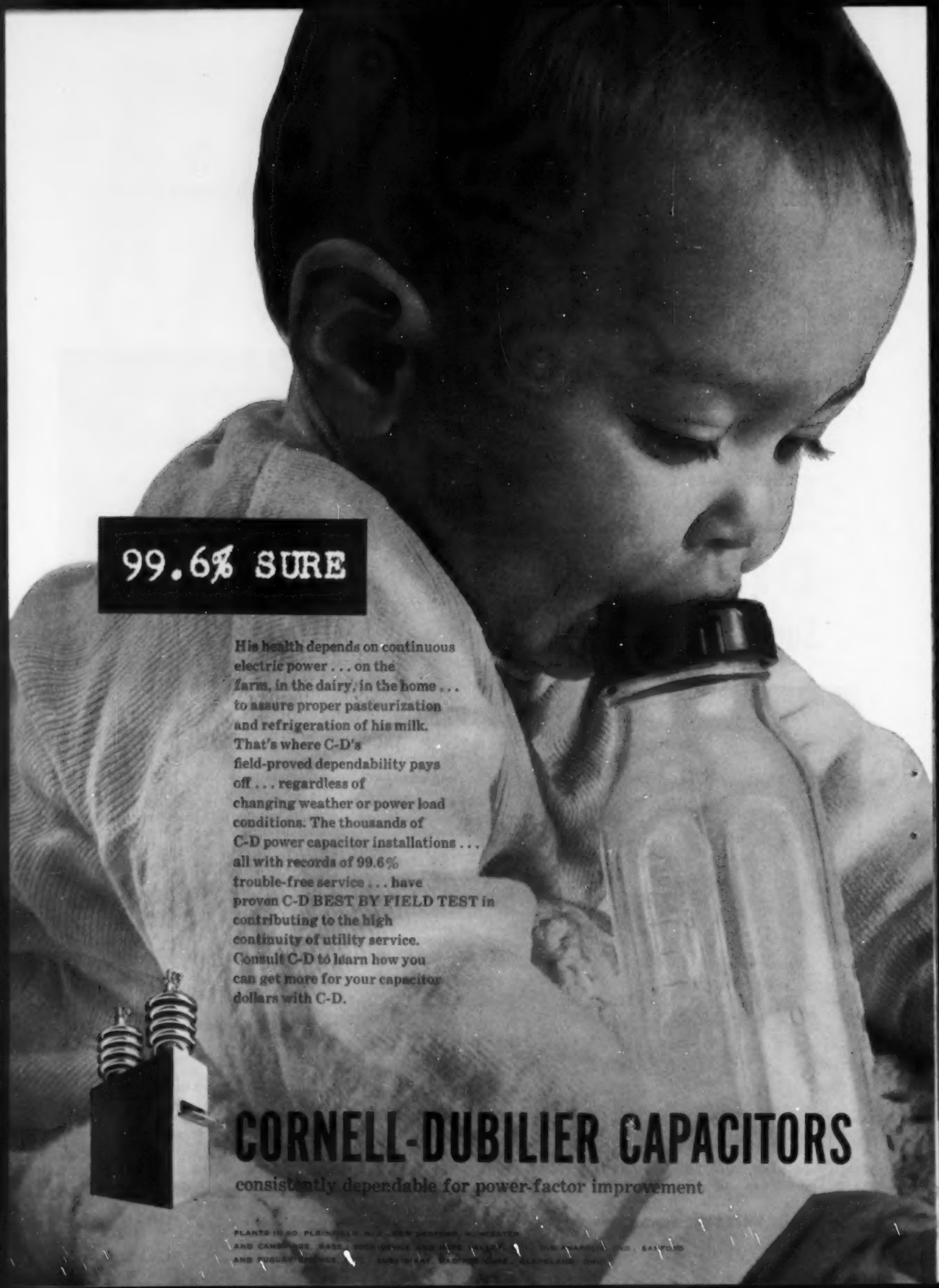

99.6% SURE
His health depends on continuous electric power . . . on the farm, in the dairy, in the home . . . to assure proper pasteurization and refrigeration of his milk. That's where C-D's field-proved dependability pays off . . . regardless of changing weather or power load conditions. The thousands of C-D power capacitor installations . . . all with records of 99.6% trouble-free service . . . have proven C-D BEST BY FIELD TEST in contributing to the high continuity of utility service. Consult C-D to learn how you can get more for your capacitor dollars with C-D.
CORNELL-DUBILIER CAPACITORS
consistently dependable for power-factor improvement

CORNELL-DUBILIER power-factor capacitors give you better than 99.6% trouble-free service*

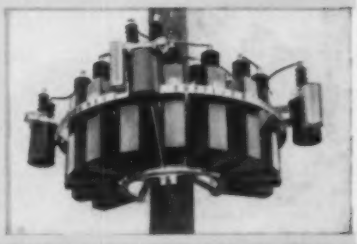
Lowest volts per mil unit stress results in the extra margin of safety necessary to withstand all system high voltage transients. This lower volts per mil and lower volts per section feature is the utility's assurance of extra longevity in its capacitor purchase when Cornell-Dubilier's are specified.

Only C-D power capacitors are subjected to a full-rated voltage energization test. C-D removes potential trouble-makers before they get on your poles . . . not after with costly replacements.

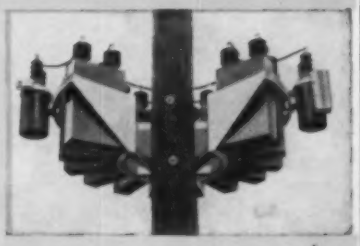
Lowest unit dielectric stress not only provides lowest voltage gradient for steady state operating conditions, but also highest withstand protection against the transients produced by lightning, circuit breaker re-strikes and all other line surges.

Heavy major insulation in the form of laminated liners, with reinforced corners insures highest impulse withstand levels. It means, too, a heavier capacitor unit . . . because it's a better unit . . . but at no extra cost to you. How would you relate a slight increase in weight to years of trouble-free service?

Why is it that only C-D power capacitors give you assurance of complete dependability?... because C-D's built-in safety factor results from the ultimate in tried and proven design levels coupled with conservative production techniques and rigorous quality control. For catalog write to Cornell-Dubilier Electric Corporation, South Plainfield, N. J.



C-D's new semi-round pole mounting Contour Capacitor® Rack.



*This is an average based on reports from leading utilities using C-D capacitors. Many of these reports have shown 100% trouble-free service, and none lower than 98.9%.

RELAY PANEL-WIRING by one or two-man teams can be done on this dolly

Wiring Own Relay Panels Cuts Costs and Time

ARTHUR DREXEL, Assistant Engineer, Florida Power & Light Co, Miami, Fla.

Florida Power & Light Co has reduced costs of wiring aluminum alloy relay switchboards by assigning this work to company electricians. The procedure also assures faster construction when necessary and provides similar wiring in the new and existing panels.

Switchboard wiring by company electricians began about 2 years ago when manufacturers were unable to meet the delivery schedule for switchboard equipment. Corrosion-resistant aluminum-alloy stock, suitable for providing a level surface, was chosen for panel construction.

Four coats of paint were applied to the face and sides of the 28 x 90 x ⅛-in. panels. These were a zinc chromate primer coat, an intermediate "preparakote," and two coats of grey automotive lacquer. Most panels have a small swinging sub-panel, using a stainless steel hinge and two fasteners.

A specially constructed "rack-dolly" permitted tilting and rolling of the panel for convenience of the electricians. Two men, either standing or sitting, were able to work simultaneously on a panel by tilting it into a horizontal position.

These electricians, familiar with maintenance problems of panel wir-

(*Continued on page* 146)

SPRAGUE MODULINE

supervisory device for remote 24

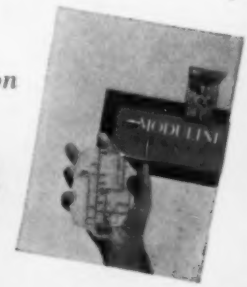
electric transmission and

THE MODULINE MONITOR, a power line carrier system, is used for monitoring the operation of oil circuit breakers, transformers, transfer switches and other equipment in unattended substations and on transmission, subtransmission, and distribution circuits.

A single Moduline Monitor is capable of supervising up to 25 points or functions simultaneously. And only a single carrier channel is required to supervise these 25 points from any desired location, however remote.

The Sprague Moduline Monitor is the product of more than seven years of intensive research. It embodies new methods and circuits which were developed specifically to meet the exacting requirements of utility system monitoring. A comprehensive description of the Moduline Monitor and its theory of operation is contained in Sprague Bulletin MD-7002, which will be sent at your request. ★ ★ ★ ★

**and by far the most economical equipment for this important application*



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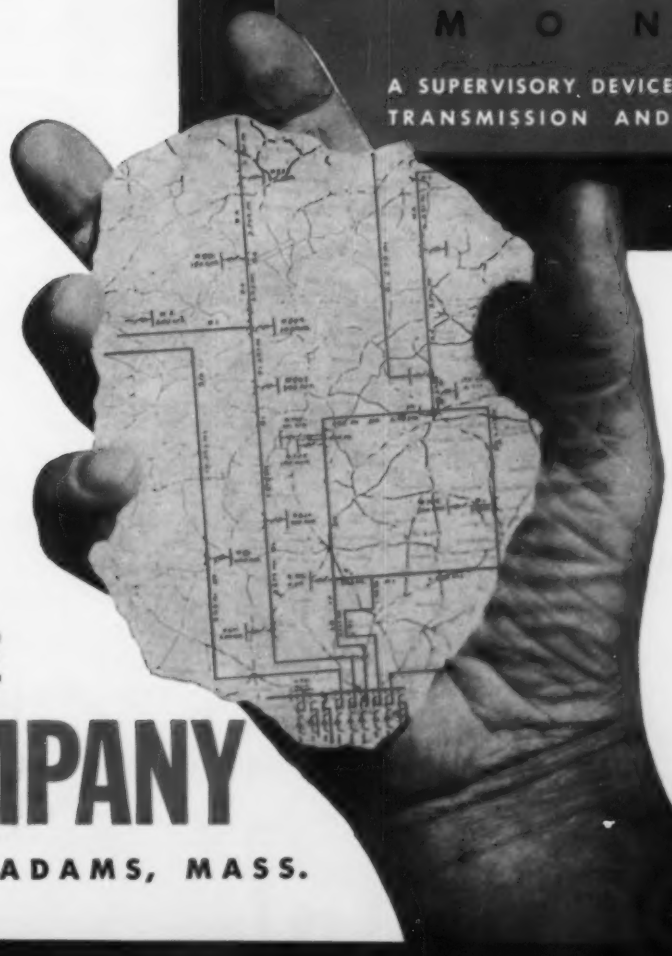
MONITOR

A SUPERVISORY DEVICE FOR MONITORING ELECTRIC TRANSMISSION AND DISTRIBUTION SYSTEMS



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LINE CONSTRUCTION AND MAINTENANCE EQUIPMENT

HC EARTH BORING MACHINE

MW-128 UTILITY TRUCK BODY

IU-76 INSTALLER'S UNIT

PWD-2 CABLE REEL TRAILER

Highway line construction and maintenance equipment — designed for safety, dependability, economy and long, trouble-free service life — the most completely engineered equipment available today.

That's the reason Highway equipment is more widely specified and used than *any other*. Highway's complete, experienced engineering service and extensive production facilities mean the right solution to *your* problems too! Call, wire or write for full information and specifications today.

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SALES AND SERVICE IN PRINCIPAL CITIES

Relay Panel Wiring

(*Continued from page* 143)

ing, incorporated features in the switchboards for facilitating upkeep. They allowed space to facilitate removing leads for test purposes and made the leads long enough to be easily removed. They used a wire grille with oblong slots because it was more practical than the punched single hole for each wire.

TESTING CART avoids tying up the permanently installed loading equipment for special test purposes

Transformer Cart Reduces Testing Time

A portable cart with transformers attached simplifies testing of such equipment as oil reclosers, cable, connectors, and fuses. Cincinnati Gas & Electric Co has found that the test cart saves time and avoids tying up permanently installed high-current loading equipment for special tests. When not in use it can be rolled to any convenient out-of-the-way place for storage.

The cart measures 25 x 32 x 30 in. and was constructed by Electric Meter Department employees from angle iron and plywood. It has four 5-in. casters, and the top working surface is covered with linoleum and trimmed with chromium.

Mounted on the lower shelf of the cart are a-loading transformer, three autotransformers with chokes, and associated terminals. Loading transformer can be connected in parallel for outputs up to 1,000 amp at 11 v or in series for 500 amp at 22 v.

(*Continued on page* 151)

How Careful Should You Be for 32¢?

Before this man was born, O-B was routinely testing 100 per cent of its pintype insulator production by flashover. Now, such testing is a requirement of national standards.

Inspecting today's output to reject today's errors goes only part way toward protecting the insulator buyer. Compare this to decades of testing history in the hands of an able technical organization anxious to improve its product. Long ago, before we *had to* apply total inspection we did it by *choice* on an insulator that, even now, sells for only 32 cents! Long ago, too, O-B users found they were spared the drudgery of roaming over country roads or up and down alleys on a stormy night looking for lightning-damaged insulators.

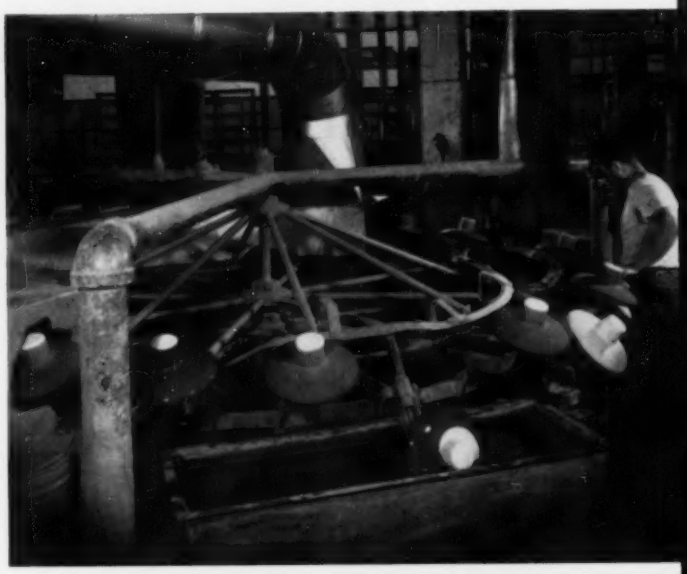
In the many years we have performed total inspection, the occasional rejects have gone direct to research men in the laboratory where lessons could be learned leading to a better product. In this way, protection for the buyer goes much further than merely throwing away and, perhaps, hoping to forget today's defective pieces.

And it gives a lot more meaning to the question: "How careful should you be for 32 cents?"

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

Putting An Extra Layer of



Glaze has certain minor advantages on an insulator. It resists accumulation of dirt because of its glossy surface. Its color sometimes permits you to identify a certain maker's product. But these are incidental to the big job it does. By controlled shrinkage, this thin skin is put under compression. By a combination of balanced compression, toughness, and adhesion to the porcelain base, a properly employed glaze can add 25 per cent or more to the strength of an insulator.

Note that we said, "properly employed." Thickness of the glaze, especially over critical areas of the insulator, must be accurately controlled. For 17 years (well over 20,000,000 O-B suspension insulators) this has been a precision operation in our plant. But it hasn't stood still these 17 years. It has probably seen as many detailed improvements as any process we have, and it is still a full-time job for a crew of highly trained technical men.

The story of precision glazing has too many ramifications to be told completely in a few pages, but some of its chapters may shed new light on the care we take in *just one step* of suspension insulator manufacture. It is another practical and valuable application of Technical Competence, the heart of every O-B insulator.

OHIO BRASS COMPANY, MANSFIELD, OHIO

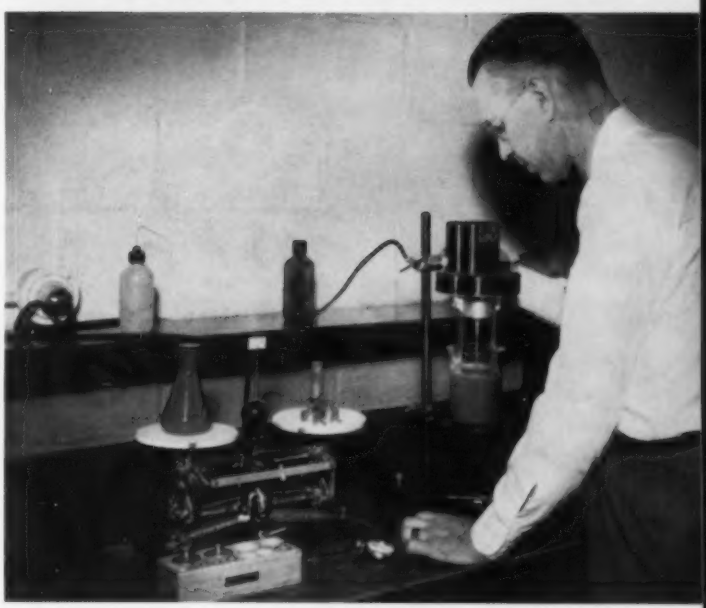
In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

Strength On A Suspension Insulator

For brevity and clarity, we will tell the glazing story in reverse order; starting with the final step and working back toward how we control it. Here is the automatic glaze dipping machine which rotates the insulator disc during a timed dip in the glaze bath, then permits partial drying to avoid damage in handling. The original of this machine was built by us in 1938 and, in its 17 years of use, has seen many improvements. Since the speed of the machine is fixed, the dipping time is constant. Therefore, the characteristics of the glaze bath determine many of the physical aspects of the process. In order to attain exact thickness of the glaze coat, this process must be highly controlled.

We operate what has been called "a factory within a factory" -- an experimental pilot plant where every process is duplicated in small scale with special controls to permit either exactly matching or varying factory conditions. This manually controlled laboratory dipping machine may be adjusted to the same rpm speed as the factory equipment, and immersion time is controlled by a stop watch. Regular or experimental glazes, thus, may be applied under either standard or varied conditions. These insulators are fired in a special controlled-program kiln or in our regular plant equipment. Specimens are often fired both ways as a check.

Leaving the product, we take another step backwards into pure technical control. Size and shape of an insulator introduce variables in a strength study. Therefore, we use the simplest of shapes; small cylindrical test bars made to an exact standard of size, thus ruling out all but glaze variations. Dipping is done by hand under careful time control. Present glaze compositions are constantly checked and improvements often investigated. After firing, each bar is broken on a precision testing machine to determine the amount and consistency of strength imparted by the glaze coating. Thousands of such bars are always in process. In this practical way, a glaze composition is evaluated.



When a glaze has been compounded it has a thin, creamy consistency. This, however, cannot be a hit-or-miss condition. Remember that the factory dipping equipment runs at a constant speed. Accordingly, the amount of glaze picked up in a fixed dipping period depends greatly on the exact density of the glaze bath. To determine this, specific gravity and viscosity are both accurately measured; the first by weight determination and the second by precision instrument that rotates a disc in the solution and reads the "drag" imposed by the viscosity of the sample. By means of this test, the amount of glaze applied to an insulator may be accurately computed. We thus constantly exercise both qualitative and quantitative control over the precision operation of glaze application. This, in turn, permits us better to exploit the possibilities of high strength glazing techniques.

the heart of every Ohio Brass insulator

We have often pointed out how the Potter's art, even when applied to modern high-voltage insulators, has its traditions. For example, we read and record kiln temperatures by the finest optical and electric pyrometer equipment, yet the last word is spoken by a simple little set of pyrometric cones invented in the 1870's by a German ceramist named Seger.

These cones have the advantage of being able to read the effect of heat right at the product, as they are distributed throughout the ware when it is placed on kiln cars. Furthermore, they explore every zone of the kiln because of their distribution. The center cone takes a specific amount of droop when heated for a given time at a temperature of about 2,300 degrees F. The two "guard cones" react at about 36 degrees F plus and minus. They therefore provide precise measurement in all firing regions of the kiln interior.

Must we be so exacting? Under-fired porcelain may be porous -- it would absorb moisture if the porosity were at the surface or, if trapped within the body of an insulator, would lower its

An 85-Year-Old Precision Instrument Guards O-B Porcelain Quality

dielectric strength. Over-fired ware is subject to gassing, again resulting in porosity. Correct vitrification is essential to a sound insulator, and the Seger cone acts as a sensitive indicator, right where it's wanted!

Sometimes the essence of progress is being smart enough to retain old-fashioned methods when they do a job. And, while we use the newest and finest equipment available to read and control firing temperatures, the 85-year-old pyrometric cone still provides us fundamental and valuable data.

Evaluating the basic *good* in a process -- realizing that in an art as ancient as Pottery, men knew a lot about it long ago -- is an important part of Technical Competence, the heart of every O-B insulator.

OHIO BRASS COMPANY, MANSFIELD, OHIO

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the heart of every Ohio Brass insulator

4511-H

Transformer Cart

(*Continued from page* 146)

Overloads in excess of 200% can be obtained for short durations when they are desired.

Three autotransformers permit varying the load. They are mounted with a common shaft and connected in parallel with choke coils to balance the loading between units, for use on single phase.

TRANSFORMER ON WHEELS obviates interruption while regular transformers undergo needed maintenance or repairs

Mobile Transformer Insures Continuous Service

A transformer-on-wheels is being satisfactorily used for emergency service by the Jersey Central Power & Light Co. Built according to company specifications, the transformer is rated 37.5 kva, is self-cooled, and mounted in a trailer. The cables, which have extra thick jacket and insulation, emerge from a vent on top of the trailer cabinet. Safety devices, such as flashing red lights when the transformed is energized, are used. Provisions for grounding are also provided. Total weight of the unit runs about 2,000 lb.

Twelve of these units are strategically located throughout the company's territory. They can be moved rapidly into the field and put into use as a substitute for a permanent installed unit undergoing repairs, thereby eliminating interruption of service.

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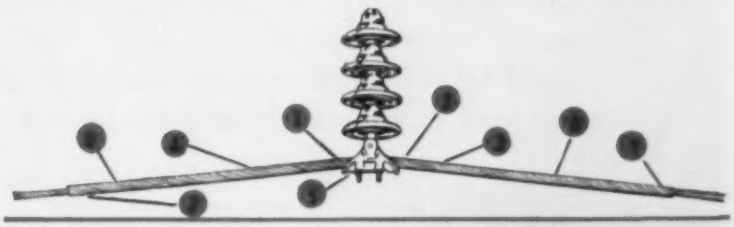
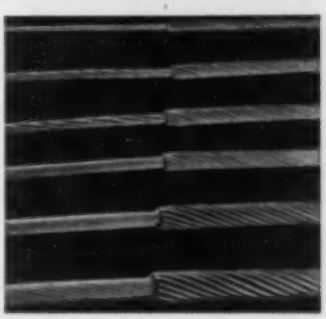
Their *VERSATILITY* means ECONOMY plus these *ADVANTAGES* (and more):

1. **Conductor protection against harmful effects of vibration.**
2. **Ends chafing and pitting of conductor by loose line components.**
3. **Elimination of damage to conductor in case of power arcs.**
4. **Conductor strength and conductance restored where damaged.**
5. **Benefits from smaller and closer fitting clamps.**
6. **Complete reusability — time after time.**
7. **Permanent "self-clamping" action for life of the application.**
8. **Facilitated hot-stick application when necessary.**
9. **Conductance of armor comparable to that of conductor.**



• High standards in design and production of FANNER SUPERFORMED ARMOR RODS based on over 50 years of manufacturing provide unvarying uniformity of application and service. Consult our agents or write direct for additional information on Superformed Armor Rods, Line Guards, Tap Armor and Patch Rods.



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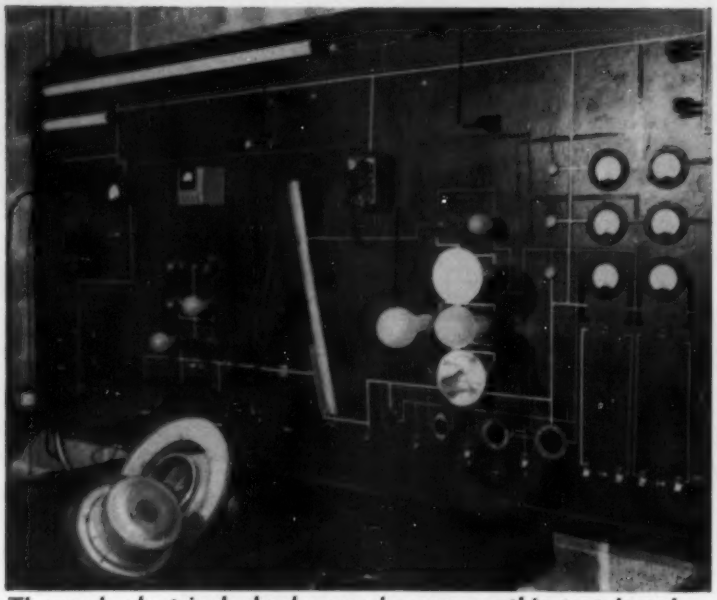
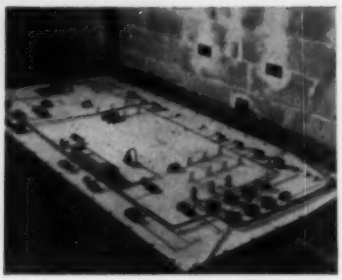


Thorough electrical checks can be run on this test board

It swings downward . . .



. . . for internal repairs

UN Maintenance Board Saves Money

Like any industrial plant, the UN's glassy office building in New York is chocked full of electrical equipment requiring checkups and repairs. Here is a test board, devised by an electrical engineer, that cuts costs . . .

Thorough checks of all electrical equipment in the United Nations building—from 1.5-v lamps to 30-hp three-phase motors—can be run quickly and easily in the sub-basement workshop of the electrical maintenance department.

A test board was created specifically to make this possible. And now, after three years of service, it is credited with paying off in fewer repair bills, time saved, and a lesser number of man hours involved in maintenance.

The board was devised by Bernard Eichwald, a New York electrical engineer. His firm is charged with keeping the UN building in tip-top electrical repair. Eichwald says industries can adapt this board to their own specialized requirements.

Technical Details . . . The board measures 4 x 8 ft. It is used in laboratory-type tests on motors, heaters, incandescent lamps, relays, cold-cathode lamps, fluorescent lamps and starter buttons, motor starters, clocks, batteries, condensers, smoke detectors, bells, fire detectors, thermostats, fuses, and switches.

Three-phase, 4-wire 120/208-v power is fed into the panel. An autotransformer is provided in each phase. Fuses in the main lines protect feeders. Thermal cutouts guard meters, transformers and equipment against overloads during tests.

Voltages of 1 to 208 may be obtained from the line through the autotransformers. Voltages of 500 to 5,000 are available from built-in transformers. A voltmeter and ammeter were put in each phase. One set of meters can be switched out to act as isolated meters in external circuits. A separate dc voltmeter measures voltages up to 250 v.

Fuses of any rating and length can be tested in an inverted "V" (shown in the middle of the board). The electrician adjusts current in the circuit by switching in lamp filaments for resistance. Two banana-plug outlets are provided at its base so that this same current can be tapped for continuity checks of motor windings, heaters, and relays.

One-, two-, and three-phase twist-lock outlets and pin-plug outlets (at the bottom of the board) enable the electrician to plug equipment directly across the line. The outlets may be switched into a series hookup if needed.

A four-color wiring diagram is painted directly on the panel. This helps the electrician trace circuits quickly, and is especially helpful to the man who is not familiar with the test board wiring. Toggle switches are

(*Continued on page* 156)

CORROSION... *Tough Utility Problem*

HARPER FASTENINGS... *Simple solution*

From turbine to transformer—substation to distribution line—all electrical equipment is subject to corrosion, the day-after-day menace to dependable electric service.

Harper fastenings protect equipment from costly breakdowns—provide added insurance against serious outages. Harper specializes in fastenings of corrosion-resistant metals—silicon bronze, copper, aluminum, naval bronze, brass, Monel, nickel and stainless steel. More than 7,000 different items are carried in stock. Skilled metallurgists and engineers are ready to consult with you on any specialized design or alloy to meet your requirements. See the Harper Branch Office or Distributor in your area, or write for Catalog 25.

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8205 Lehigh Avenue, Morton Grove, Illinois

BOLTS • NUTS • SCREWS
WASHERS • RIVETS • SPECIALS
SILICON BRONZE • COPPER • ALUMINUM
NAVAL BRONZE • BRASS • MONEL
NICKEL • ALL STAINLESS STEELS

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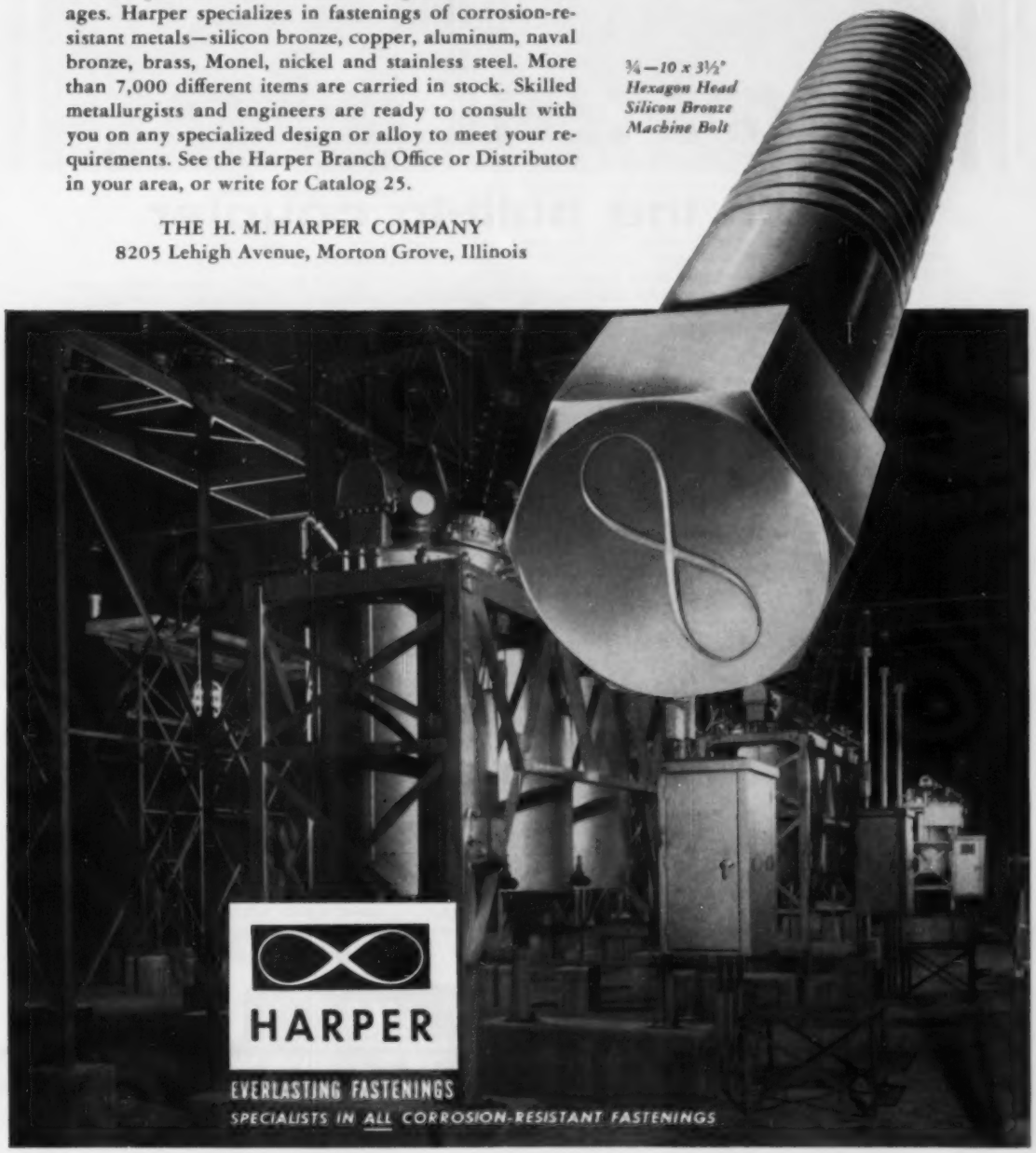
Hexagon Head
Silicon Bronze
Machine Bolt



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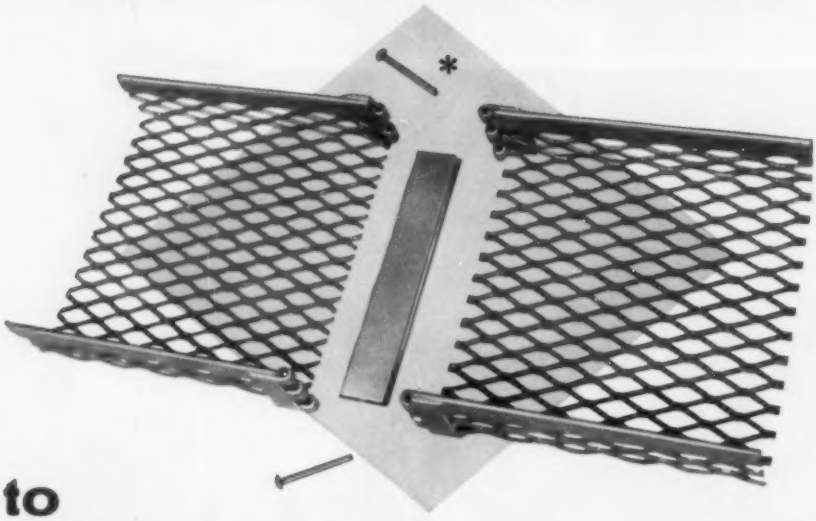
the new 70,000 series

COPE CABLE TROUGH

with the built-in coupler



up to 80% savings in assembly time

The new 70,000 Series Cope coupler is an integral part of all units. A metal "⌶" shaped piece is also supplied for each joint to fit between the ends of the mesh and thus eliminate sharp edges. Cope Cable Trough Systems are available in widths of 6", 9", 12", 18" and 24" and in straight lengths of 8', 10' and 12'. A wide range of fittings for each width permits the system to be rapidly assembled on the job site to conform to any plant layout.

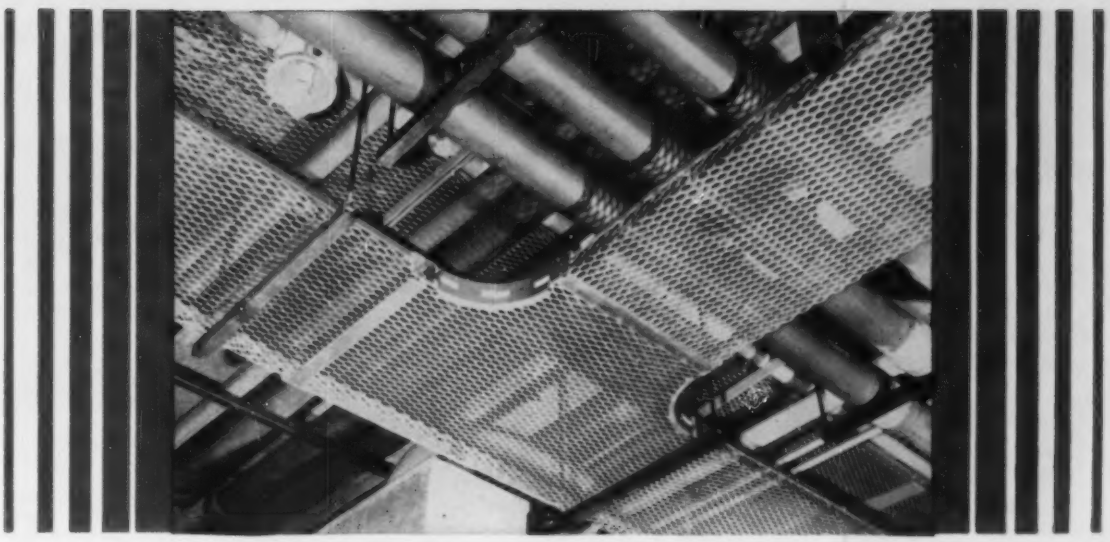
Should field cutting of the trough be required, special bolt-on couplers are available which will join the cut-off end of the trough to the regular pin-type coupler.

Cope

T. J. COPE, INC.

711 SOUTH 50th ST., PHILADELPHIA 43, PA.

*PATENT PENDING



Vineland Municipal Electric Utility • Albert C. Wood Associates, Philadelphia, Pa.,—Engineers
Gilbert and Kierstead, Inc., Philadelphia, Pa.,—Electrical Contractors

The New 70,000 Series Cope Cable Trough has a built-in coupler . . . this is typical of the constant efforts of T. J. Cope, Inc., to bring you a stronger and more economical product.

In line with these efforts, Cope pioneered and developed the acceptance of Cope Cable Trough through original design, engineering service and high quality manufacturing standards.

Now Cope has anticipated its many customers' needs for a product which will save up to 80% in erection time and give still greater strength.

Every straight length and fitting in the versatile Cope Cable Trough system now has a built-in coupler—no more nuts, bolts and washers!

The Cope Representative in your territory will be glad to explain the new coupler and show you samples so that you can have the advantage of this latest Cope development in your next new construction program or plant modernization project.

COPE REPRESENTATIVES

AMARILLO, TEXAS
Williamson Sales Co., 318 Amarillo Bldg.
ATLANTA, GEORGIA
The Gearhart Co., P.O. Box 85
Northside Station
BALTIMORE, MARYLAND
J. D. Amelia, 208 W. Chesapeake Ave.
P.O. Box 6759, Towson, Baltimore, Md.
BEAUMONT, TEXAS
Williamson Sales Co., P.O. Box 3164
BIRMINGHAM, ALABAMA
The Gearhart Co., 1727 Sixth Ave., North
BOSTON, MASSACHUSETTS
J. J. Costello Co., 131 Clarendon Street
BUFFALO, NEW YORK
Vincent J. Brown Co., 564 Ellicott Square
BUTTE, MONTANA
Monitor Distributors, Inc., 604 Utah Ave.
CHARLOTTE, NORTH CAROLINA
Glenn & Larson, 123 Brevard Court
CHICAGO, ILLINOIS
Hooper-Green Co., 407 S. Dearborn St.
CLEVELAND, OHIO
E. F. Burke Agency, 1900 Euclid Ave.
CORPUS CHRISTI, TEXAS
Williamson Sales Co., 922 Wilshire St.
DALLAS, TEXAS
Williamson Sales Co., Slocum at Cole St.
DEARBORN, MICHIGAN
George R. Horne & Co., 22187 Michigan Ave.
DENVER, COLORADO
Hamilton Associates, 1236 Elati Street
DES MOINES, IOWA
Geo. W. Swallow, Chas. L. Ward Co.
5707 Waterbury Circle
HOUSTON, TEXAS
Williamson Sales Co., 5541 Armour Drive
HUNTINGTON, WEST VIRGINIA
Muller, Harper & Assocs., Inc.
P.O. Box 1736
INDIANAPOLIS, INDIANA
Hooper-Green Co., 6216 Carrollton Ave.
JACKSON, MISSISSIPPI
Williamson Sales Company
P.O. Box 3223, West Jackson Station
KANSAS CITY, MISSOURI
Chas. L. Ward Co., 3122 Roanoke Road
LOS ANGELES, CALIFORNIA
H. J. Randolph Co., 736 Santa Anita St.
San Gabriel, Calif.
LOUISVILLE, KENTUCKY
Hooper-Green Company
319 Marion E. Taylor Bldg.
MIAMI, FLORIDA
The Gearhart Co., 416 Langford Bldg.
MINNEAPOLIS, MINNESOTA
The Klass Company, 814 So. Ninth St.
NEW HAVEN, CONNECTICUT
J. J. Costello Co., P.O. Box 88
NEW ORLEANS, LOUISIANA
Williamson Sales Co., 210 Delta Bldg.
NEW YORK, NEW YORK
David M. Miller Co., Inc., 31 Nassau St.
OKLAHOMA CITY, OKLAHOMA
Harold E. Bates, Chas. L. Ward Co
3125 N.W. Grand Blvd.
PHILADELPHIA, PENNSYLVANIA
The Bradley Co., Inc., 3341 Arch St.
PINE BLUFF, ARKANSAS
Williamson Sales Co., P.O. Box 3
PITTSBURGH, PENNSYLVANIA
Muller, Harper & Assocs., Inc.
First National Bank Bldg.
PORTLAND, OREGON
Fred W. Carlson, 935 Northwest 12th St.
ST. LOUIS, MISSOURI
Edwin S. Waterman
494 Arcade Bldg., 812 Olive Street
SAN ANTONIO, TEXAS
Williamson Sales Company, Box 1324
SAN FRANCISCO, CALIFORNIA
Geo. E. Hann Co., 420 Market Street
SEATTLE, WASHINGTON
Fred W. Carlson, 2307 Fifth Avenue
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Williamson Sales Company, P.O. Box 1223
SYRACUSE, NEW YORK
Vincent J. Brown Co., 218 Harrison St.
CANADA
CALGARY, ALBERTA
Bunston, Ltd., 510 9th Avenue, West
DORVAL STATION, P.Q. (Montreal)
Marshall Equipment Co., Inc., P.O. Box 28
VANCOUVER, B.C.
Bunston, Ltd., 2532 Yew Street
WINNIPEG, MANITOBA
Norman L. Haney & Co.
34-221 McDermot Ave.
FOREIGN
MANILA, PHILIPPINE ISLANDS
Communications Electrical Equipment & Supply Co., Inc., 517 Dasmarinas
P.O. Box 58
SANTURCE, PUERTO RICO
Victor M. Garcia, 1357 Ponce De Leon Ave.

ANOTHER EXAMPLE OF Cope EFFICIENCY. . .

Write today for the new Cope Bulletin which illustrates and describes the New Cope Cable Trough with the built-in coupler. Ask for Bulletin W-4

The Old Reliable

EVERSTICK ANCHORS...

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life

● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way, and cone types. Write for facts.

AN EXCLUSIVE
EVERSTICK
FEATURE
Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturer of "THE ANCHOR OF MERIT"
FAIRFIELD, IOWA

Maintenance Money Saver

(*Continued from page* 152)

situated so that the position of the lever indicates, for instance, whether meters are connected to the internal or external circuits.

Other Tests . . . To the right and slightly above the inverted V is a capacitance bridge. By hooking an unknown capacitor across the bridge, then adjusting the dial for maximum deflection in the "magic eye," the electrician can determine its value quickly. The device measures all values from 10 mmf to 50 mf.

To the left of the inverted V, and at about the same level, is a device the electricians use to determine what capacity is required to start a motor. Capacitors in these motors sometimes are burned beyond recognition, and their capacities are unknown. Selected capacities are switched in the starting circuit. The proper value brings the motor up to speed in 2 sec.

A tapped transformer supplies circuits with 2½, 5, 6, 12, and 24 v. (The terminals are shown at the far left.) This circuit is equipped with a bell and buzzer for probing low-voltage windings and for checking continuity.

The test board is energized with a magnetic switch operated by a specially designed foot treadle. The switch kills the whole board when the electrician takes his foot from the pedal. This eliminates the chance that someone will get shocked by live wires should the electrician walk away.

A special arrangement beneath the work bench enables smoke detectors to be tested. Watching with photoelectric eyes the air that is exhausted from rooms in the UN buildings, these delicate mechanisms trip off all ventilating fans when smoke exceeds a given density.

Built-In "Smoke" . . . The smoke detector's test mechanism in the bench bottom consists of a photoelectric device. Detectors are plugged into the black box shown in the bottom picture. The box beams light to the photoelectric cell at the other end of the bench through a large pipe (barely shown in the top photo). A smaller pipe carries wires.

(*Industrial Briefs on page* 158)

Foot switch turns on power

Toggle adds lamp resistance

Magic eye "sees" capacitance

Smoke smeller gets checked

SOUND *Cornerstone* FOR YOUR NEW PLANT

Ebasco's half century of experience is a solid foundation on which to base the new plant you are considering today.

In that time Ebasco has engineered and constructed *more than two billion dollars of new plants*: large plants and small, in the United States and abroad, built for many different industries. Each bears the unmistakable stamp of the skill and integrity of Ebasco specialists; each is an example of *quality* engineering and construction.

Your new plant, too — whatever its size or function — will benefit from the broad experience which Ebasco will apply to every aspect of the project — from site selection and preliminary planning, through detailed designs and finished construction, to successful and economical operation.

For more information about our services, write for "The Inside Story of Outside Help." Address: Ebasco Services Incorporated, Two Rector Street, New York 6, N.Y.

1905 *Fiftieth Anniversary* 1955

ENGINEERS · CONSTRUCTORS
EBASCO
BUSINESS CONSULTANTS

NEW YORK · CHICAGO · DALLAS
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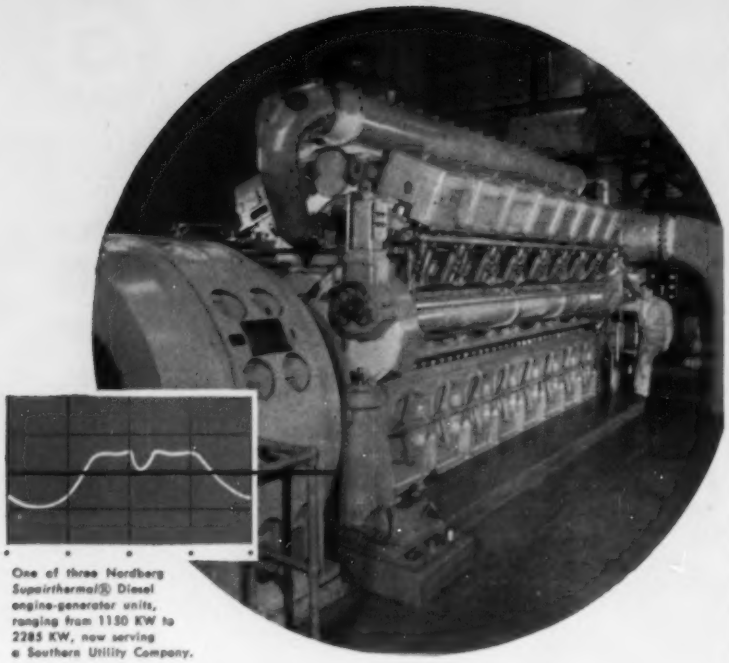
Appraisal · Consulting Engineering · Design & Construction · Financial & Business Studies · Industrial Relations · Insurance, Pensions & Safety
Purchasing, Inspection & Expediting · Rates & Pricing · Research · Sales & Public Relations · Space Planning · Systems, Methods & Budgets · Tax · Washington Office



One of three Nordberg Supairthermal® Diesel engine-generator units, ranging from 1150 KW to 2285 KW, now serving a Southern Utility Company.

Reduce *peak load* generating costs with NORDBERG DIESELS

● If your base generating station is having a difficult time "topping the load" at an economical figure, it will pay you to investigate the advantages of Nordberg engine generating units. These efficient prime movers are easily installed, go on the line quickly and provide low cost power generation under all load conditions.

Many utilities have assigned their peaking problems to Nordberg Diesel, Duafuel® and Spark-Ignition Gas engines. In doing so these modern companies have also added desirable generating flexibility and standby protection while at the same time amortizing their investment through more profitable operation.

As builder of America's largest line of heavy duty engines, Nordberg offers specialized experience second to none, in helping to find the most dependable, economical solution to your specific power problem. Write for further information.

NORDBERG MFG. CO., Milwaukee, Wisconsin

NORDBERG

DIESEL • DUAFUEL® AND SPARK IGNITION GAS ENGINES

© 1955, Nordberg Mfg. Co. P255

AMERICA'S LARGEST HEAVY DUTY ENGINE LINE . . . 10 to over 10,000 H.P.

INDUSTRIAL BRIEFS

High-intensity fluorescent lights, installed over tanks where paint-matching and tinting is done, have eliminated previous troubles with glare and outside light variations for Western Paint Co, Duluth, Minn. Sixteen 96-T-12 tubes produce 200 ft-c at the tank tops where matching and tinting is done. G. B. Spurbeck, Industrial Sales Manager, Minnesota Power & Light Co, Duluth, Minn.

New incandescent lighting, highlighted by reflector floods over inspection areas, helped transform a dark, dismal mill building bought by American Paper Products Co, Eden, Pa., into a modern plant. Management noticed that "shiftless" workers quickly drifted away and labor turnover practically ceased. Norman S. Hartman, Industrial Representative, Pennsylvania Power & Light Co, Lancaster, Pa.

Heated platform of simple and inexpensive design has overcome effects of cold drafts on the legs and feet of a wood joiner operator stationed near a large truck door at Canton Barrel & Bag Co, Canton, Ohio. The operator walks on a 2 by 5-ft by 3-in. platform of solid steel decking which was enclosed beneath by bending its edges down to make a supporting bevel. Four 250-w heaters, 1 in. below the deck, warm its surface to comfortable temperatures. H. T. Fessler, Industrial Power Engineer, Ohio Power Co, Canton, Ohio.

A resistance heater, installed to replace a dangerous, inefficient oil-fired steam heating system, has yielded Polaris Concrete Products Co, Duluth, Minn., better temperature control on the asphalt heating operation, plus easier handling, higher efficiency, and greater safety. A 2.3-kw heater was chosen for the job. G. B. Spurbeck, Jr, Industrial Sales Manager, Minnesota Power & Light Co, Duluth, Minn.

A hoist driven by a three-phase motor is saving $600 yearly in fuel costs for Regan & Fisher Co at its Ferndale mine. Replacing a gasoline-powered hoist, the electric unit also is yielding continuity of service, thus saving time. John Chaplinsky, Industrial Representative, Pennsylvania Power & Light Co, Pottsville, Pa.

VICTOR "KNOW-HOW"

Plus

Purified Porcelain

...Give You America's Finest Pintypes!

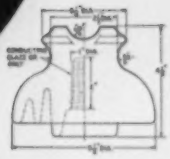
VICTOR Low Voltage Pintypes are the result of the combined "know-how" acquired through ceramic, electrical and mechanical research.

VICTOR Pintypes are made of *Purified* Porcelain, finest insulator porcelain ever made! They are designed with rugged cross section for maximum strength and resistance to impact. They have large-radius top and side wire grooves to permit use of new larger conductors, and smooth hard glaze for maximum self-cleaning in contaminated areas. Every insulator is thoroughly tested to assure continuity of service.

VICTOR Pintypes last longer, cut line maintenance costs to a minimum. You'll save money by specifying **VICTOR**.

FEATURES

1. **PURIFIED PORCELAIN** provides highest dielectric and physical strength.
2. **RUGGED CROSS SECTION** gives maximum strength and resistance to impact.
3. **RESEARCH-ENGINEERED DESIGN** minimizes outages.
4. **LARGE-RADIUS TOP AND SIDE WIRE GROOVES** permit use of new larger conductors.
5. **MECHANICALLY APPLIED GLAZE** results in high strength with smooth, self-cleaning surface.
6. **ACCURATE PINHOLE GAUGING** —every lot must pass NEMA standards for pinhole thread accuracy.
7. **ROUTINE ELECTRICAL FLASHOVER TEST** is given every pintype before shipment.



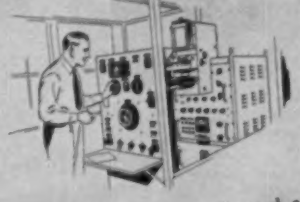
Specifications

60 cycle Dry Flashover	70 KV
60 cycle Wet Flashover	40 KV
Pos. Impulse Flashover*	110 KV
Neg. Impulse Flashover*	140 KV
Dry Arcing Distance	5"
Leakage Distance	9"
Rec. pin height	5"
Cantilever Strength	3000 lbs.
Low Freq. Puncture Voltage	95 KV
RNI (plain)	5500 microvolts
RNI (radio-freed)	50 microvolts
1000 KC at applied KV	10 KV

*Crest KV. 1½ x 40 microsecond wave Critical Value

For the full facts on Victor "Know-how", write for "The Story of Victor and Purified Porcelain." For engineering data on Victor insulators, write for Bulletin No. 4.

NEWS FROM VICTOR



Shown in the drawing above are the control panel and Oscillograph for the impulse generator in the Victor electrical laboratory. This equipment is being used to study the effects of high surge voltages on both present and projected insulator designs.

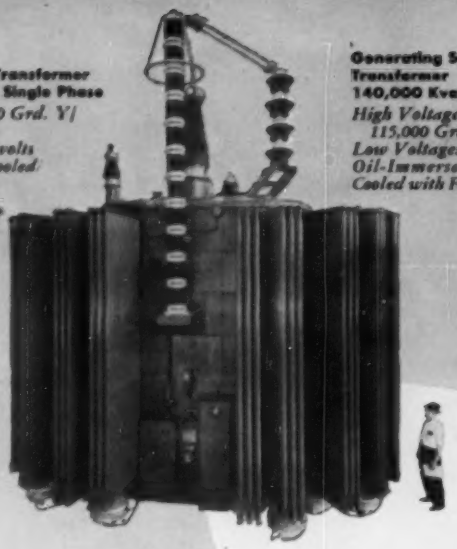
SPECIFY *VICTOR*

Purified Porcelain Pintypes

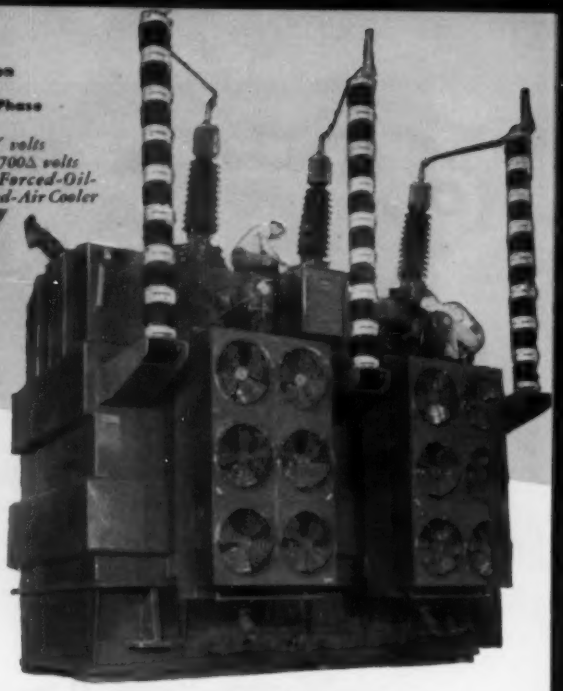
VICTOR INSULATORS DIVISION
I-T-E CIRCUIT BREAKER CO.
VICTOR, N. Y.

Low and High Voltage Pintypes • Suspensions • Guy Strains
Spools • Switch and Bus Insulators • Custom Designed Porcelain
Insulator Hardware

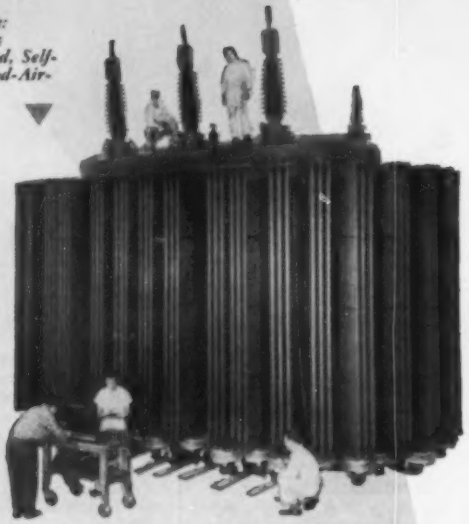
Generating Station Transformer
56,000/70,000 Kva, Single Phase
High Voltage: 161,000 Grd. Y/ 93,000 volts
Low Voltage: 19,000 volts
Oil-Immersed, Self-Cooled/ Forced-Air-Cooled



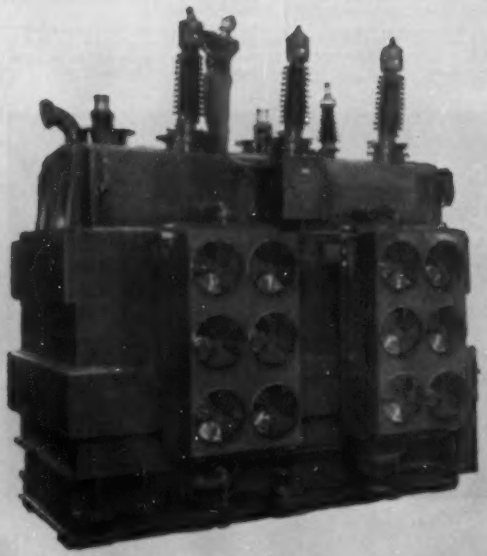
Generating Station Transformer
140,000 Kva, 3 Phase
High Voltage: 115,000 Grd. Y volts
Low Voltage: 14,700Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler



Generating Station Transformer
68,000/90,666 Kva, 3 Phase
High Voltage: 132,000 Grd. Y/ 76,200 volts
Low Voltage: 13,200Δ volts
Oil-Immersed, Self-Cooled/Forced-Air-Cooled

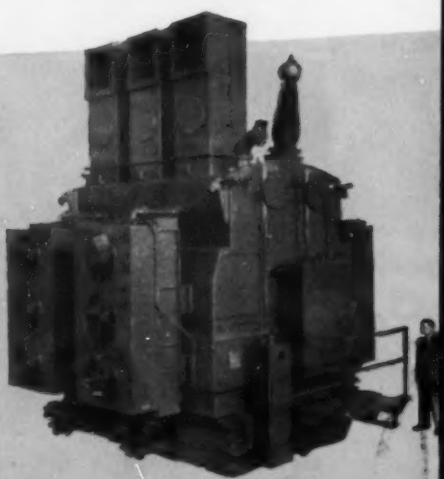


REPRESENTATIVE Power Transformers MANUFACTURED BY PENNSYLVANIA IN 1954

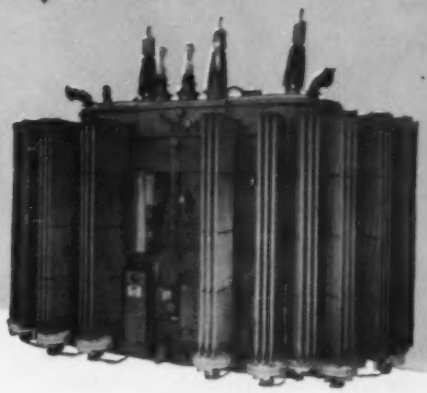


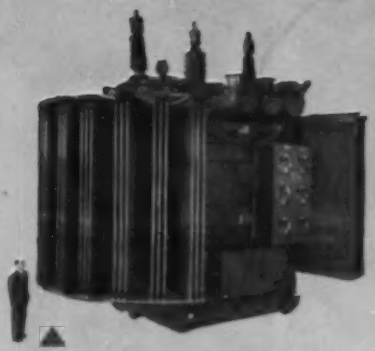
Generating Station Transformer
175,000 Kva, 3 Phase
High Voltage: 115,500 Grd. Y volts
Low Voltage: 17,500Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler

Generating Station Transformer
120,000 Kva, 3 Phase
High Voltage: 145,000 Grd. Y volts
Low Voltage: 19,800Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler



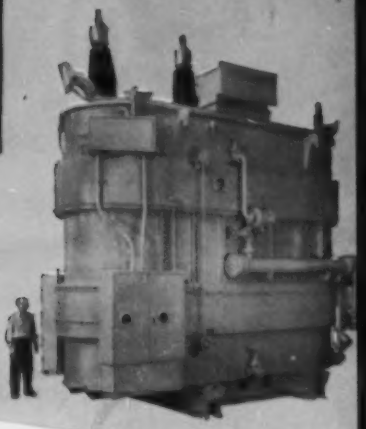
Generating Station Transformer
36,000/70,000 Kva, 3 Phase
High Voltage: 132,000Y volts
Low Voltage: 15,000Δ volts
Oil-Immersed, Self-Cooled/Forced-Air-Cooled





Substation Transformer
45,000/60,000 Kva, 3 Phase
High Voltage: 125,400Δ volts
Low Voltage: 13,800Y volts
Oil-Immersed, Self-Cooled/Forced-Oil-Cooled with provision for future OA/FOA/FOA rating of 75,000 Kva

Generating Station Transformer
48,000 Kva, 3 Phase
High Voltage: 115,000 Grd. Y volts
Low Voltage: 13,200Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Water Cooler

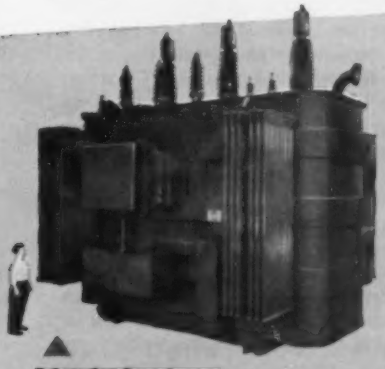


Here are some of the single phase and three phase power transformers manufactured by Pennsylvania in 1954. They are representative of the large core-form and contour-design (shell-form) transformers that are preferred by leading utilities and industrials. Some of these units are for generating station service. Others are typical power transmission transformers. Every type of cooling method is represented in these transformers. Typical accessories include load tap changing mechanisms, lightning arresters, and potential devices. In short, these transformers represent Pennsylvania's complete coverage for the large power transformer needs of this country.

Expanded plant facilities also made it possible for Pennsylvania to offer transformers in ratings up through 350,000 Kva and in voltages through 330 Kv. This includes load tap changing transformers up to 150,000 Kva.

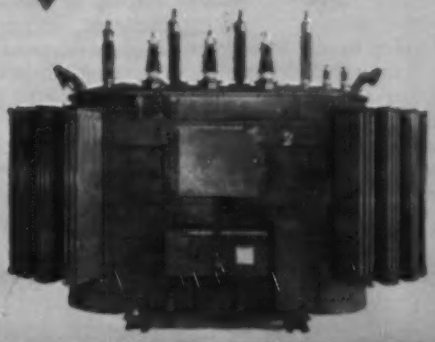
It is significant, too, that 1954 was a record-breaking production year at Pennsylvania, indicating in a concrete manner the trust placed in Pennsylvania Transformer Company, its people and its products.

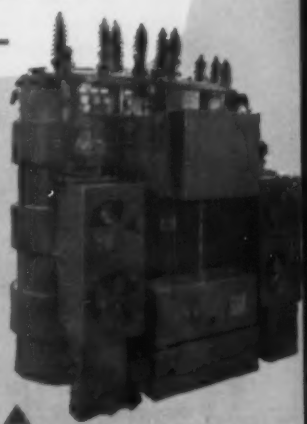
PENNSYLVANIA TRANSFORMER COMPANY . CANONSBURG, PA.
A McGraw Electric Company Division



Substation Transformer
15,000 Kva, 3 Phase, with load tap changing equipment
High Voltage: 154,000Y volts
Low Voltage: 69,000 Grd. Y volts with plus and minus 10% regulation in 32–⅝% steps
Tertiary Voltage: 12,470Δ volts
Special design for shipping in one-piece tank

Substation Transformer
25,000 Kva, 3 Phase, with load tap changer
High Voltage: 138,000Y volts
Low Voltage: 69,000 Grd. Y volts with plus and minus 10% regulation in 32 — ⅝% steps
Tertiary Voltage: 12,400Δ volts
Oil-Immersed, Self-Cooled





Substation Transformer
30,000 Kva, 3 Phase, with load tap changing equipment
High Voltage: 66,000Y volts, with plus and minus 5% regulation in 32 — ⅝% steps
Low Voltage: 33,000Y volts
Tertiary Voltage: 13,800Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler

TV'S ROXANNE, C. A. Stevens, PSE&G, celebrate 1st birthday of Beauty Plus

HOUSEWARES ROLE IN HOME is discussed by Mildred Lessenich, Home Service chairman, left, Ruth D. Kruger, Arizona PS, Elizabeth Parker, Georgia Power

EEI Sales Conference (continued)

". . . Sell up to all-electric home; use all of the available channels . . ."

Committee told the residential sales group. Coe announced that his committee is developing a program of long-range planning of promotional material. Aim, he says, is to provide advance information to interested parties on a schedule that will bring all promotional forces to bear on the same campaign at the same time.

Got The Lead Out . . . The day when the adequate wiring program could be referred to as a "lead balloon" is gone, said Norman Wicks of the National Adequate Wiring Bureau. The program is off the ground, he said, and has been since the people of the industry quit talking solely to themselves and started telling the adequate wiring story to consumers.

Utilities have an important stake in the changes that are taking place in the appliance distribution picture, Laurence Wray, editor, "Electrical Merchandising" told the group. If the discount dealers drive other dealers out of business the utility may need to do merchandising to protect their interests, Wray said. "Proper loading building . . . is difficult to achieve where only accepted appliances are sold on price alone. "Who is going to sell the need for low-saturation appliances?" Along with this, he added, the job of servicing equipment will be thrown into the utility's lap. Other items:

- Fifty manufacturers are producing Beauty Plus lamps and 96 utilities are now promoting them since organization of the Beauty Plus program a year ago, reported D. E. Bootes, chairman of EEI's Residential Lighting Committee.
- Home service girls are planning a series of regional workshops, Mrs. Mildred Lessenich, Home Service Chairman said. A handbook for conduct of the meeting has been drafted.

Home Service Conference

The home service woman's role in selling electricity themed the Home Service Conference. Some highlights:

- Coordinated campaigns with the dealer build his interest.
- Results from calls on homemakers can justify the cost.
- Follow the lead of merchandisers in other fields—sell up to complete electrification.

Importance of the youth market in selling was emphasized by Elizabeth Parker of Georgia Power Co who described programs underway in various utilities.

Get at The Market's Heart . . . Making personal calls on homemakers had paid off in several ways for Philadelphia Electric Co, said Judith O'Flaherty, PE home economics supervisor. They pay off in fewer complaints, increased sales and revenue, and in better customer relations.

Sales successes through group contacts in Pacific Gas & Electric Co's large service area were described by J. S. C. Ross, manager of domestic sales. "Through cooking schools, demonstrations, lectures and special activities, we made more than 100,000 contacts last year at an average cost of 66¢ each or 5¢ per residential customer."

Dealer Has The Ball . . . "But it's still the dealer who does the actual selling job," pointed out J. R. Waters, residential promotion manager, Monongahela Power Co. "If he doesn't close the sale, it isn't closed." Dealers aren't interested in the battle of the fuels, he said, utilities must woo them. "If utilities will follow through by planning their own promotions to coincide with EEI's coordinated campaign calendar, use display materials and slogans, and hold distributor-dealer meetings during the 'build-up', we can get the kind of dealer tie-in that will result in increased sales and profits . . ."

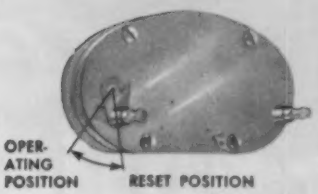
Detroit Edison Co's Paul L. Penfield demonstrated what can be done in residential lighting and wiring through cooperation with builders. Don Willis, vice president of Arizona Public Service Co capped the program by outlining the home service woman's responsibilities. "Sell up—take a tip from the rocket," he cried shooting a smoking miniature rocket over the heads of the audience.

For Award Winners see page 166

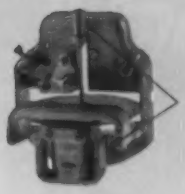
The Meterman's Meter

NEW DUNCAN SINGLEPHASE METER TYPE MK*

*MK means More KVA

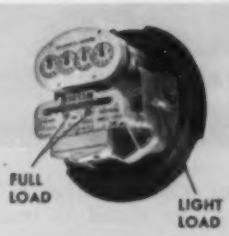


CONVENIENT REGISTER RESET

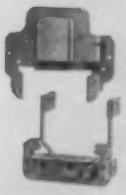


NO BEARING ADJUSTMENTS NECESSARY
—tighten against fixed shoulders

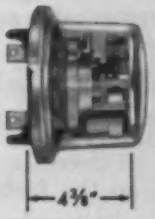
PERMANENT WORM WHEEL MESH



ADJUSTMENTS ACCESSIBLE FROM FRONT

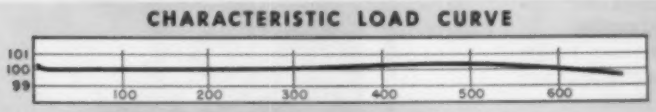


SEPARABLE ELECTROMAGNETS
for ease of maintenance



SMALL, COMPACT SIZE

—and with Full 100-Amp "Extended Range"



Duncan Type MK 15-ampere, 240-volt, 3-wire

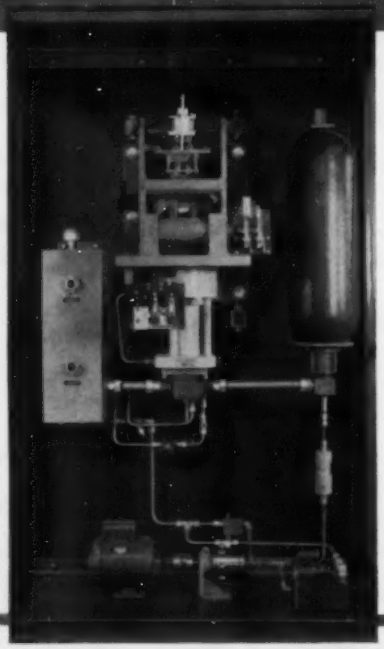
Your Dollar Now Buys More Metering Capacity

Pioneers in Extended Range Metering

DUNCAN

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE INDIANA

Pneu-Draulic already in use on

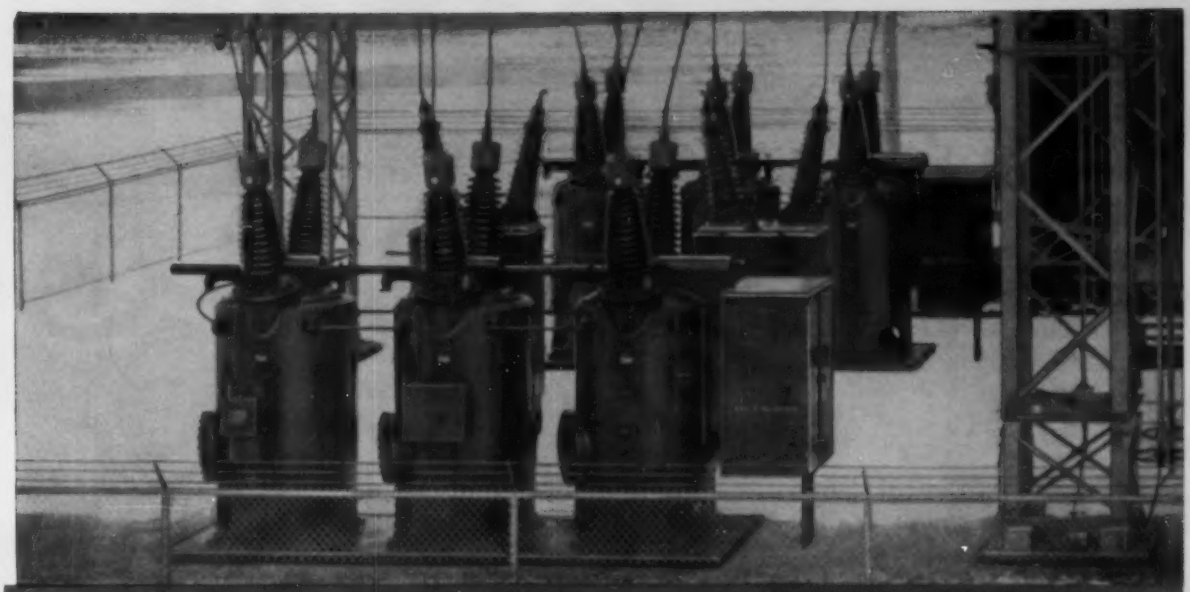


Here's the story of the remarkable acceptance of this new principle of operation. Not only are 15 systems now using breakers with *Pneu-Draulic* operators, but within six months this figure will be doubled.

Acceptance is based on the fact that the *Pneu-Draulic* operator looks simple... and is simple. It eliminates the mechanical problems inherent in previous designs. Call your nearby A-C office for information, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4588

Pneu-Draulic is an Allis-Chalmers trademark.

ALLIS-



Operators 15 power systems

Check these 7 reasons why you too should insist on breakers with Pneu-Draulic operators

1 Simple — Has fewer parts than other types of operating mechanisms.

2 Unaffected by Temperature — Whether it's hot or cold, the energy stored in the system provides more than standard number of operations. Use of oil with constant viscosity over wide range of temperatures insures uniform performance.

3 Eliminates Moisture and Corrosion Problems — Entire system is filled with oil containing inhibitor which eliminates rust, freezing and corrosion.

4 No Dust Problem — Offers protection of a sealed system. Efficient filtering eliminates dust and dirt problems.

5 Fast — Actually could be set to operate at speeds far faster than present useful speeds.

6 Emergency Closing — Can be closed at full speed onto energized line even when no control power is available.

7 Mechanically Trip-Free—Simple mechanically trip-free mechanism, proven on other Allis-Chalmers high speed breakers, has been adapted to the *Pneu-Draulic* operator.

CHALMERS

A-C ALLIS-CHALMERS

JUBILANT OVER THEIR NEW RECOGNITION, representatives of winning companies sit down to luncheon in their honor

Here Are The Award Winners

For their outstanding sales promotion work in 1954, these electric power companies received these prizes at EEI's sales conference

GEORGE A. HUGHES AWARD—Hotpoint Co, Donor
Electric Range Promotion
Florida Power & Light Co
Accepted by J. H. Keele
Mississippi Power & Light Co
Accepted by J. J. Powell
Electric Water Heater Promotion
Florida Power & Light Co
Accepted by J. H. Keele
Portland General Electric Co
Accepted by George E. Sullivan
Commercial Cooking Promotion
Texas Power & Light Co
Accepted by E. H. Gardiner
Kentucky Power Co
Accepted by E. C. Cassidy

PLANNED LIGHTING AWARDS—Better Light Better Sight Bureau, Donor
Commercial Lighting
Pennsylvania Power & Light Co
Accepted by E. P. Werley
Consumers Power Co
Accepted by W. A. Stannard
Mississippi Power & Light Co
Accepted by F. G. Smith
Residential Lighting
New Orleans Public Service, Inc
Accepted by C. J. Sinnot
Union Electric Co of Missouri
Accepted by R. L. Coe
Industrial Lighting
Cleveland Electric Illuminating Co
Accepted by R. W. Wynn

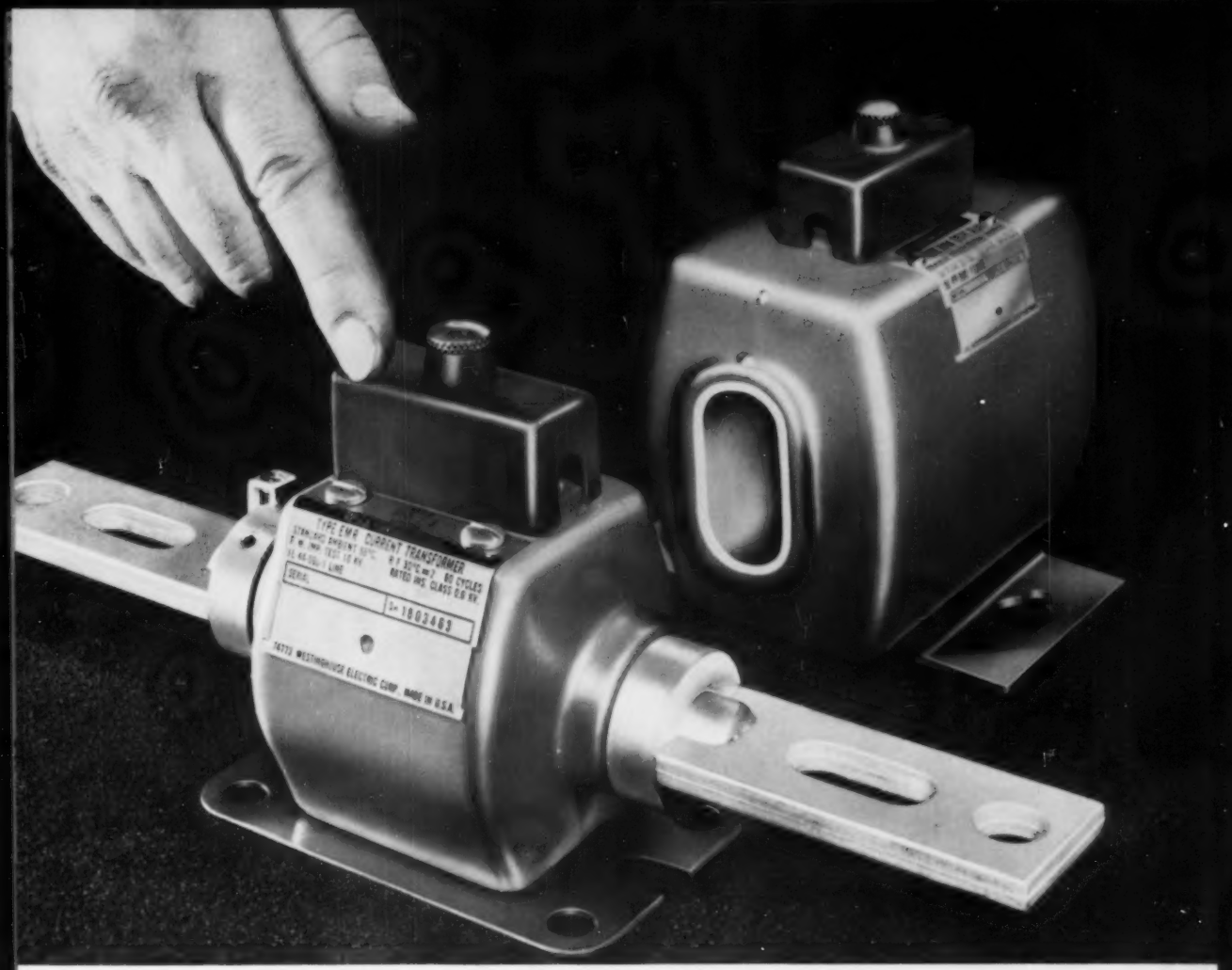
THOMAS W. MARTIN AWARD (for rural electrification)—Thomas W. Martin, chairman of the board, Alabama Power Co, Donor
Texas Power & Light Co
Accepted by Homer N. Gibbs

FRANK WATTS AWARDS—Farm Journal, Inc, Donor
Alabama Power Co, 1st Prize
Accepted by M. B. Penn
Dayton Power & Light Co, 2nd Prize
Accepted by E. D. Smith
Pacific Gas & Electric Co, 3rd Prize
Accepted by Walter D. Howell

MORE POWER TO AMERICA AWARDS (for industrial electrification)—General Electric Co, Donor
Pennsylvania Power & Light Co
Accepted by S. F. Diffenderfer
New Orleans Public Service, Inc
Accepted by J. F. Morton

GEORGE WESTINGHOUSE AWARDS (for home laundry promotion)—Westinghouse Electric Corp, Donor
Washington Water Power Co, 1st Prize
Accepted by Gordon F. De Foe
Pennsylvania Electric Co, 2nd Prize
Accepted by Robert W. Smith

LAURA McCALL AWARDS—McCall's Magazine, Donor
Ruth D. Kruger, Arizona Public Service Co
Edna F. Moore, Empire District Electric Co
Mildred S. Ditzel, Dayton Power & Light Co
Ruth L. Hicks, Alabama Power Co
Marguerite G. Surles, Carolina Power & Light Co



NEW TYPE EMR (LEFT) AND TYPE EMO (RIGHT) CURRENT TRANSFORMERS

Polyester molded for lighter weight, longer life

Outstanding is the word for the new Westinghouse Types EMR and EMO indoor-outdoor current transformers for 600-volt service. They are lighter, smaller, more durable and more pleasing to the eye than any comparable units.

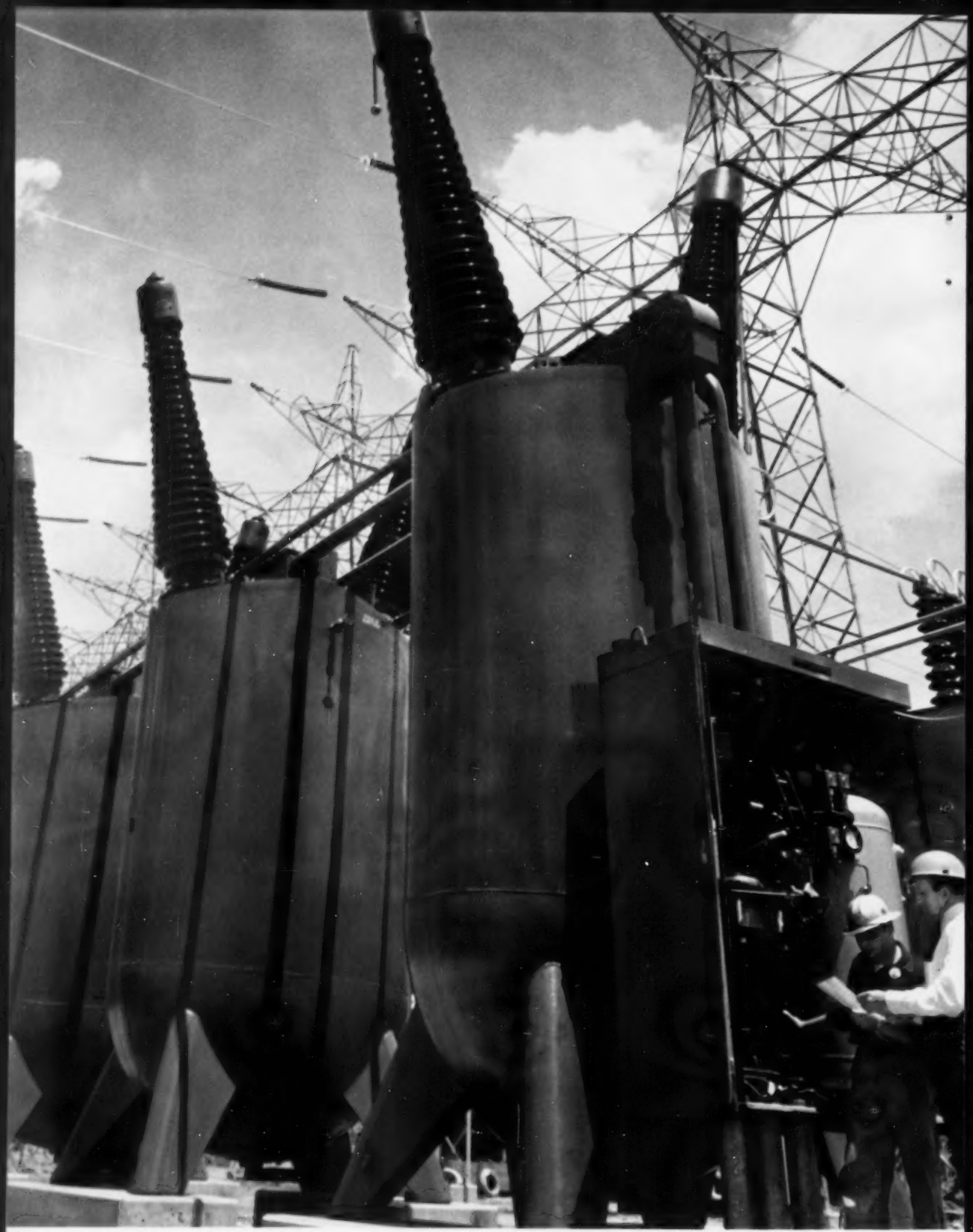
Both are molded of a polyester elastomer insulating material that has excellent thermal and dielectric stability—remains physically flexible at high or low temperatures. Both use exclusive Hipersil® cores—a major factor in their small size and superior performance. And both have rating factors of 2.0. The EMR and EMO (200/5 A.) have 0.3 accuracy classification at B-0.1 and B-0.2. The EMO (400-600-800 A.) maintains this accuracy also at B-0.5.

The EMR has a round primary opening and is available with or without a removable round or flat terminal bar. The EMO features an obround opening for use with multi-cable primaries. They may be installed in any position—on virtually any type of mounting.

For full details, call your Westinghouse representative, or write for B-6520, Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70749

YOU CAN BE SURE...IF IT'S

Westinghouse



Engineers are shown checking control of this giant 330,000-volt circuit breaker, rated at 3-cycle interrupting, 15-cycle reclosing. This is the first of 18 assembled here in an average time of less than 5 days per breaker.

Helping the industry meet its growing loads

World's first 330-kv, 25,000,000-kva breaker installation

Electrical history was made at Portsmouth, Ohio, in the summer of 1954. There in the A.E.C. 330-kv switchyard, the installation of the world's first 25,000,000-kva breaker was completed—the first of 18 huge Westinghouse "Watchcase*" breakers of this rating now located in this station.

These giant breakers . . . an extension of the low-oil content "Watchcase" design . . . were assembled on their foundation in an average time of less than 5 days each.

Here are other outstanding advantages of this Westinghouse "Watchcase" breaker:

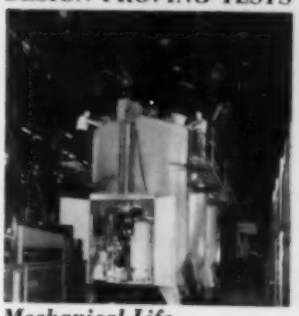
- It permits use of low-cost bushing current transformers and potential devices.
- It has a single pneumatic operating mechanism for simultaneous 3-pole closing.
- Condenser bushings eliminate radio interference problems.
- Every performance characteristic is fully proved by factory tests.

Integrated manufacture and unit responsibility . . . from idea to blueprint, from porcelains to contacts, from mechanism to interrupters . . . are the story of Westinghouse ability to help you meet America's power needs. J-97190

*Trade-Mark

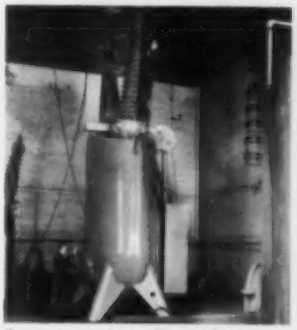
YOU CAN BE SURE...IF IT'S **Westinghouse**

DESIGN-PROVING TESTS



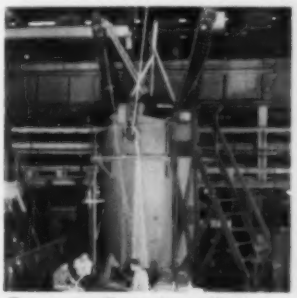
Mechanical Life

. . . proved by more than 5000 three-pole mechanical operations.



Interrupting Capacity

. . . proved by over 3000 interruptions in the High Power Laboratory.



Current-Carrying Ability

. . . proved by complete temperature tests with over 200 thermocouples.

Insulation Ability

. . . proved by hundreds of 60-cycle and impulse tests in the High Power Laboratory.

New, intermediate rating for drop-out type power fuses

It's the Westinghouse DBA-5—rated 1/2E to 200E with an interrupting capacity of 500,000 equivalent kva—available in 34½, 46 and 69-kv sizes in standard current characteristics.

This latest rating in the family of dry-type De-ion® boric acid fuses, developed by Westinghouse over 20 years ago, fills the operating requirement gap between the 4000-ampere I. C. DBA-1 and the 14,000-ampere I. C. DBA-2 (at 69 kv).

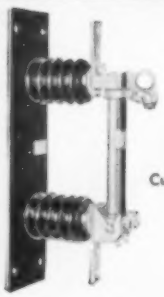
Exactly interchangeable in DBA-2 mountings, the DBA-5 provides a low-cost method of meeting growth in interrupting capacity by merely changing fuse capacity.

The DBA-5 is just one of a complete line of Westinghouse boric acid power fuses suitable for most applications where compact and economical short circuit protection is required.

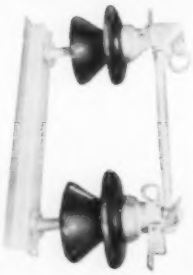
For complete information, get in touch with your Westinghouse Representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60873

YOU CAN BE SURE...IF IT'S Westinghouse

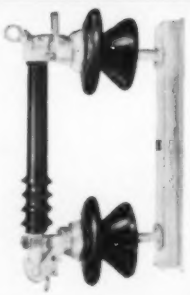
A complete line of DE-ION boric acid power fuses for all applications.



Type BAL
Current Limiting



Type DBA
Drop-out



Type BA
Vented and
Condenser

CP-1031

Gas Prices Spur Dispatch

(*Continued from page* 119)

integrated system. As practically all of the aluminum pot-line load is adjacent to large generating plants, any change in such load can be reflected as negative changes in the nearby plant loadings. The pipe-line pumping load is so well scattered over the system that variations in its load factor can be neglected. Middle South's 1951 loading schedules provided for many conditions involving a major unit out for overhaul. Experience with the older schedules showed that new schedules were required only in some cases to account for units out of service.

To develop convenient methods of keeping abreast of changes, such as fuel price variations, the Middle South System operator, together with Ebasco engineers, worked with IBM on studies made on the type 604 accounting machine, the device used by many power companies for accounting and customer billing. This project, completed last year, furnished the method first used by Middle South. Some ten additional schedules have been made locally by Middle South at Pine Bluff, bringing up to date the major schedules made at East Pittsburgh by Ebasco and Middle South.

This method, it is believed, can be successfully applied to all future schedules and even to a general revision and as might be necessitated by fuel price changes affecting several plants.

Shuffleton Additions Forecast by PSP&L

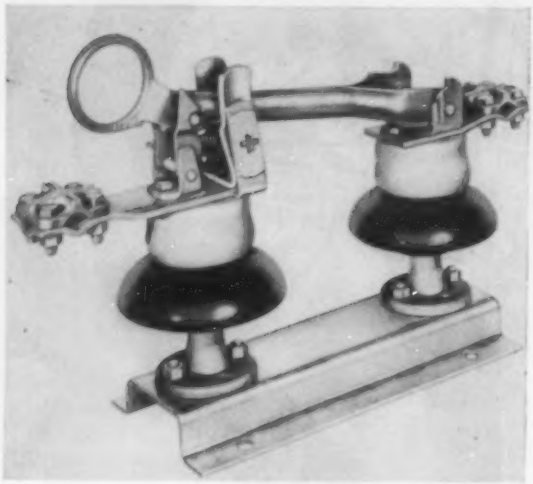
Calling into service of the Shuffleton steam power generating plant of the Puget Sound Power & Light Co near Seattle during the current low water period on the Columbia River, which caused Bonneville Power Administration to curtail interruptible-power deliveries, led L. E. Karrer, PSP&L's executive vice president, to forecast large plant additions.

Now producing more than 80,000 kw for the aluminum industry, the plant can be enlarged to generate 500,000 kw, Karrer said.

"The company is studying the situation closely and is prepared to plan expansion just as rapidly as more steam power is required," said Karrer.

WHEN
CABLE LIFE
IS THE BIG
FACTOR...
specify Collyer
SUPRENE
(Neoprene sheathed Type RR)
It pays to specify Collyer Suprene (Type RR) for both aerial and underground installations where long life is vital. Costs of cable maintenance can be planned out of your circuits when you specify Collyer — the quality cable. Available in shielded or unshielded constructions, for either standard or made-to-order specifications for all voltage ranges. Send for samples, prices and recommendations.
COLLYER INSULATED WIRE CO., 245 ROOSEVELT AVENUE, PAWTUCKET, R. I.

NEW EQUIPMENT



Disconnect Switches

Outdoor, hook-operated, disconnect switches are said to offer trouble-free service in sectionalizing, disconnecting, or bypassing applications. They may be either pole or structure mounted in a vertical or inverted position. Type PES is a single pole, single throw switch, and type PED is a single pole, double throw switch. Both are rated at 400 and 600 amp, 7.5 to 69 kv.

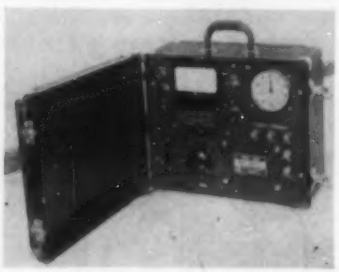
Switch blades are extruded tubes with a heavy section of back-up copper to provide extra strength and greater thermal capacity. Other features include a minimum of current interchange points and a positive blade lock-in and pry-out device. Terminal clamps are adjustable for a wide range of conductor sizes.

Line Material Co, Milwaukee 1, Wis.

Test Instrument

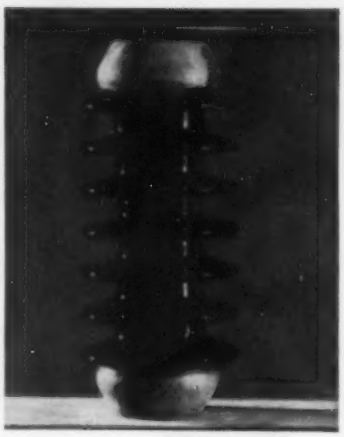
Portable high current instrument tests and calibrates overload relays, meters and circuit breakers. The typewriter-size instrument permits safe and speedy trip-time checks on protective devices before installation or while on the line. It produces primary currents, adjustable in stepless increments, which pass only through devices under test. Built-in ammeter and electronic stop timer give a complete picture of equipment behavior under simulated operating conditions.

Model 1004/44/60 has a timer totalizing 60 min in sec and 1/100's of a min. Model 1004/44/61 totalizes 60 sec in 1/100's of a sec and ¼'s



of a cycle. Both units are fully adjustable through following continuous duty ranges: 0-100 amp at 0-4 v, 0-50 amp at 0-8 v, 0-25 amp at 0-16 v and 0-12.5 amp at 0-32 v.

Multi-Amp Corp, 10 Third St, Newark 5, N. J.



Post Insulators

Station post apparatus insulators are designed to reduce corona and radio interference. They are said to offer protection against flashover and service interruption due to industrial contamination and fog. Hood spacing is wider to provide more effective natural cleaning by wind and rain, easier hot line washing, and increased effectiveness of leakage current.

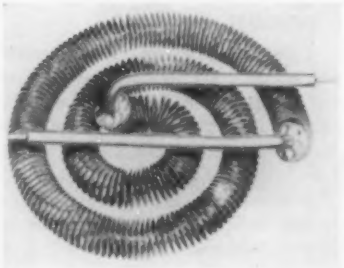
Seal of the internal cavity is said to maintain full dielectric strength throughout insulators life and give puncture-proof performance even under direct lightning strokes. Vertical member has a slightly tapered "hour glass" shape which places heavier porcelain section at the point of greatest mechanical stress. In addition, it is claimed that this shape makes leakage surface distribution more effective and spreads electrical stress more uniformly.

Insulators are available in six units with ratings ranging from 7.5 to 69 kv. Ask for Bulletin LA-106.

Locke Dept. General Electric Co, Box 57, Baltimore 3, Md.

Finned Heaters

Electrical heaters made by brazing spirally-wound steel fins to standard rod-type heating elements can be made to any desired shape. Elements are formed to shape before fins are attached to the Slim-fin heaters. Fins



may be spaced from 4 to 11 to the in. They are made with 0.312 in. tubing and ⅛ in. fins for all forms of convection heating. Capacities range from 500 to 2,000 w.

A companion line, Finrod heaters, is made with 0.540 in. tubing and

Match those long-life poles with long-life guys!

—it lasts as long as the poles

Let's face it. Modern poles last 30 to 40 years—and more. So, it's just common sense to use guy strand that lasts as long as the poles. The cost of the strand is a small part of the installation. Invest just a little more for Copperweld* Guy Strand and get a lot more service at lower annual cost.

*Trade Mark

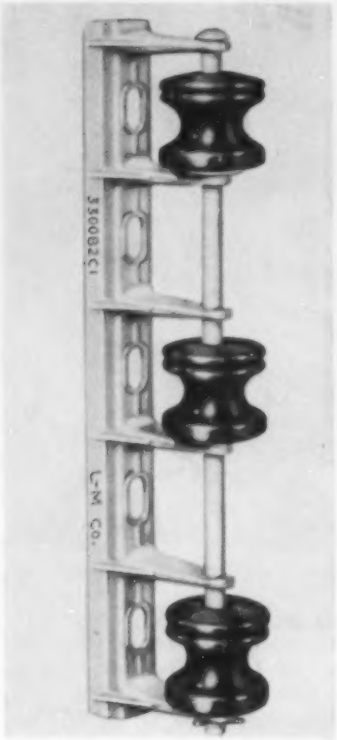
COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION
Glassport, Pa.
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

1955
—our 40th year

Copperweld GUY STRAND

1⅞ in. fins for forced-air convection heating. Capacities range from 1,000 to 10,000 w and these units can be used for 480-v operation, directly or in series.

Ferrod Mfg. Co, 603 N. River St, Batavia, Ill.



Secondary Racks

Lightweight secondary racks, designed for pole mounting, are said to provide more uniform stress distribution resulting in greater strength and less deflection at maximum loadings. They conform physically to most existing racks and are readily interchangeable with them. Racks are about one-third the weight of comparable steel units and are easy to handle and install.

The one-piece racks are made of aluminum alloy and have an aluminum thru-rod and cotter pin. Smooth contoured surfaces of projecting legs assure non-abrasion of conductor coverings during stringing operations. The absence of any overlapping surfaces tend to make them most resistant to corrosive elements.

Line Material Co, Milwaukee 1, Wis.

Data Processing

New Univac File-Computer features fast random access and muliplex monitoring in a standard electronic data processing system. Inventory, cost, or other figures on any item right up to a specific moment may be had by pressing a key. Unsorted data can be processed completely in a single high-speed program. Any and all input media such as paper or magnetic tape, 80- or 90-column punched cards, 10-key devices or typewriters, may be used. The multiplexing unit enables the File-Computer to process simultaneously several unrelated types of transactions such as inventory control, payroll, and cost distribution.

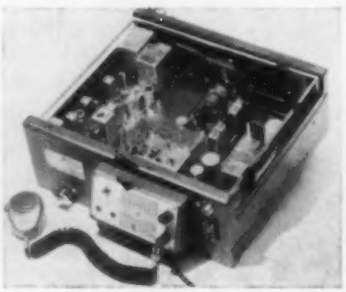
In an 8-hr day, up to 100,000 unsorted items can be entered in the computer in their order of arrival, each matched automatically with its related file data, and processed as needed, to finish several record-keeping tasks in a single program. Results are assured accuracy by a built-in self-checking feature.

Remington Rand Inc, 315 Fourth Ave, New York 10, N. Y.

Mobile Radio

Basic "building block" design of a line of FM mobile and base station 2-way radio communication equipment provides up to 60 different 2-way radio combinations. Units are available in 12 blocks consisting of 2 receiver, 4 transmitter and 6 power supply chassis. Plug-in chassis are interchangeable with other units of the same type mounted in either a base station or mobile housing.

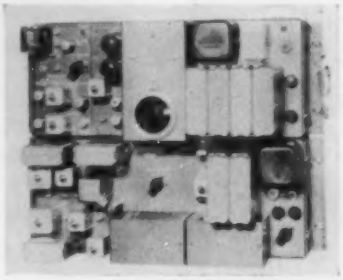
Transmitters in 25-54 mc band are



available with a medium power unit having 27-33 w output and a high power unit having 54-82 w output. In the 144-174 mc band there are also two transmitter chassis; medium power with 20-25 w output and high power with 40-50 w output.

"Progress Line" transmitters and receivers operate from either a 6 or 12 v dc source or from a 117 v ac power supply. Receivers are available for either wide band or narrow band operation.

General Electric Co, Electronics Park, Syracuse, N. Y.



Power Line Carrier

Use of transistors in power line carrier transmitters and receivers reduces power consumption up to 75%. Both units are completely transistorized except for transmitter power output stage. The transmitter power amplifier stage has a push-pull circuit which permits satisfactory operation with only one tube working. Iife of all electrical components is claimed to be extended, since the equipment operates at reduced voltages and lower temperatures. Channel spacing is 500 cycles throughout the 40 to 200 kc band.

The frequency shift carrier has a built-in universal power supply that operates interchangeably from either 129 v dc or 117 v, 50/60 cps, ac.

Motorola Communications and Electronics Inc, 4501 W. Augusta Blvd, Chicago 51, Ill.

Insulation

High dielectric films are said to perform satisfactorily in the range from 200 to 250C, depending on operating conditions. "Fiberfilm" sheet material is made from glass microfibers and polytetrafluoroethylene and is available in porous and non-porous forms. Dielectric strength ranges from 1,400 to 4,000 vpm dc, depending on type of film.

Non-porous sheet can be made in

(*Continued on page* 178)

more protection for the public . . . at a new low cost to you

Hubbard's new Glo-Guard Guy Protector

● reflects brightly in headlight glare ● easily visible on dimly lighted streets or poorly lighted areas ● readily visible to pedestrians at night ● Cor-ten steel construction assures long life, high strength and light weight at a new low cost ● top quality double dip hot galvanizing assures superior resistance to atmospheric conditions

Protect the public from dangerous projections both day and night with Hubbard's new Glo-Guard Guy Protector, with the added feature of luminous areas that glow in the dark for additional visibility.

This new Hubbard guy protector is available in two lengths, 7 feet (Stock No. 718) and 8 feet (Stock No. 818), with attachment holes and clips designed for universal application to guy wires, rods or clamps. The clips and hole spacing allow the protector to be mounted close to the ground or at any height. Heads of attachment bolts are trapped so they will not turn as the nuts are tightened.

Hubbard Glo-Guard Guy Protectors are available for immediate delivery.

Your Hubbard representative will show you a model of this new Glo-Guard Guy Protector on his next call. If you want information immediately, please contact your nearest distributor or Hubbard and Company, 6301 Butler Street, Pittsburgh 1, Pa.

HUBBARD AND COMPANY

Pittsburgh 1, Pa.
Chicago 50, Ill.
Oakland 8, Cal.

GUY FIXTURES

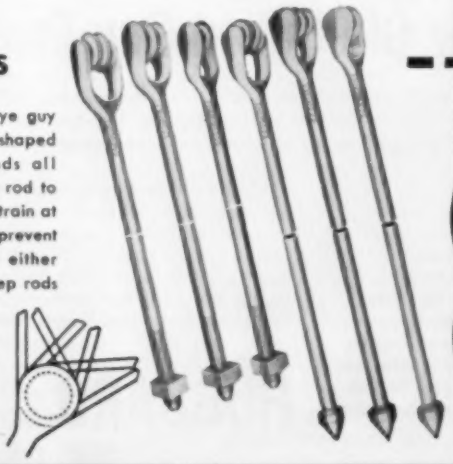
You can save time by making up guys on the ground, save and protect guy strand by using Chance guy fixtures. The full-rounded Thimbleye gives complete strand protection at any angle of pull during slack pulling operations and when in use. Chance fixtures are drop forged from high grade steel, and are heavily galvanized. The line includes Straight and Angle Thimbleye Bolts, Angle Thimbleyes, Thimbleye Nuts, Straight Away and Down Guy Loops, Guy Wire Clips, Curved Washers and Plates.

GUY GUARDS

Only Chance offers such a complete line of guy guards: The SURE-GRIP, with no loose parts to lose—nothing to take apart and re-assemble. The MONO-BOLT, that combines safety, durability and economy with simple installation—only one nut to tighten. The MATTHEWS, a one-piece protector that bolts to the guy clamp and that cannot turn or twist when installed.

GUY RODS

Choose Chance Thimbleye guy rods—with the perfectly shaped "thimble" that extends all around the head of the rod to protect the cable from strain at any angle of pull and prevent kinking. You can get either threaded or Never-Creep rods with Thimbleye, Twin-eye, or Tripleye heads for use with one, two, or three guy strands.



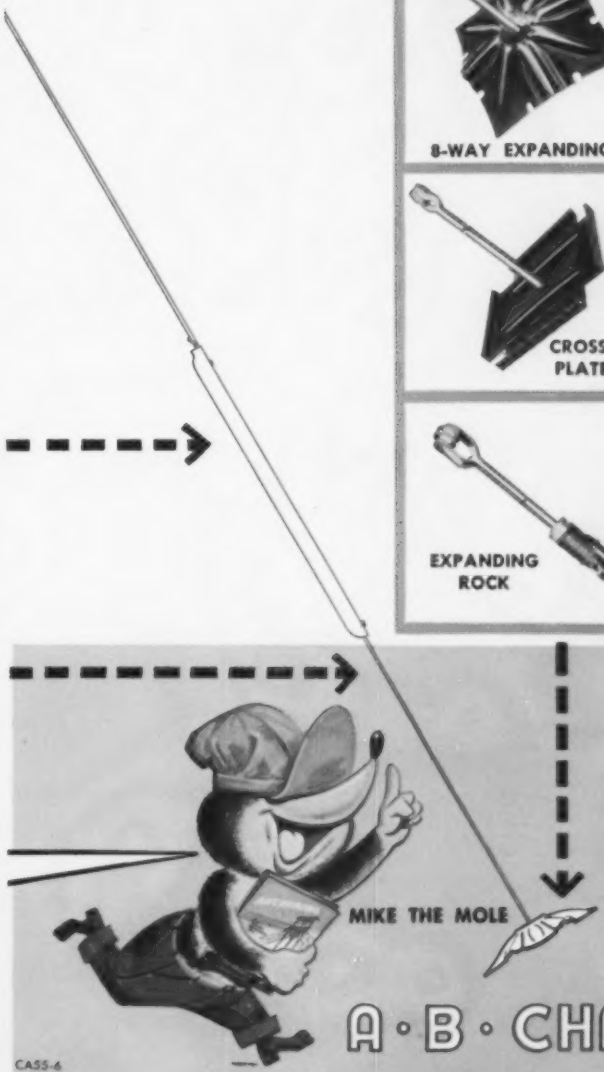
Man... this book can help you "dig" anchors better ... get yours TODAY!

Give the GUY a CHANCE

FOR THE BEST IN GUYING

Look to Chance for *all* your guying needs . . . everything but the guy strand. You can equip your crews with Chance anchor installing tools *designed* for better, faster anchor installations . . . you can choose an anchor for every soil or guying condition from this most complete line of anchors in the industry . . . add years to guy strand life with the full-rounded Thimbleye on Chance guy rods and fittings . . . select the guy guard to fit the job . . . and finish the job with Chance Guy Fixtures on the pole. You can get 'em all from one source—your Chance Distributor. For fast service plus the *best* in guying—*give the GUY a CHANCE!*

GUY ANCHORS



Here is the most complete guide to better anchoring ever developed. It's chock full of how-to-do-it material to help you select the right anchor for every guying job and install it properly. It's FREE!

A·B·CHANCE CO· CENTRALIA MISSOURI

SAN FRANCISCO, CAL.

CA55-6

DOSSON "F" SPLIT BOLT CONNECTOR

Fabricated from high strength alloys (better than average steels), the Dosson "F" is cold-formed for uniform quality. Maximum contact pressure is assured by a high translation of tightening torque. Full length pressure bars with rounded edges prevent load concentration and crushing of conductor. Built to withstand high overload, vibration. Highly corrosion resistant.

Mail coupon for FREE Dosson "F" Connector

DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

Gentlemen:
Please rush free sample Dosson "F" Split Bolt Connector plus catalog sheet.

Name _____ Title _____
Company _____
Address _____ Zone _____ State _____
City _____

50 YEARS OF TECHNICAL LEADERSHIP

DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

New Equipment

(*Continued from page* 174)

thicknesses from 0.8 to 1.7 mils and as laminations of different thicknesses. It is said to be especially useful as a dielectric for high-temperature low-loss capacitors of the wet and dry type, for interlayer insulation in coils, and in wire and cables for high temperature service.

Dielectric breakdown is 1,750 v dc for a 1.2 mil standard film and 5,900 v dc for a 2.4 mil two-layer, laminated film. Both have a dissipation factor less than 0.001 at 1 kc, a volume resistivity of 10^{18} ohm-cm at 25C, and a dielectric constant of 2.1 at 25C and 1 kc.

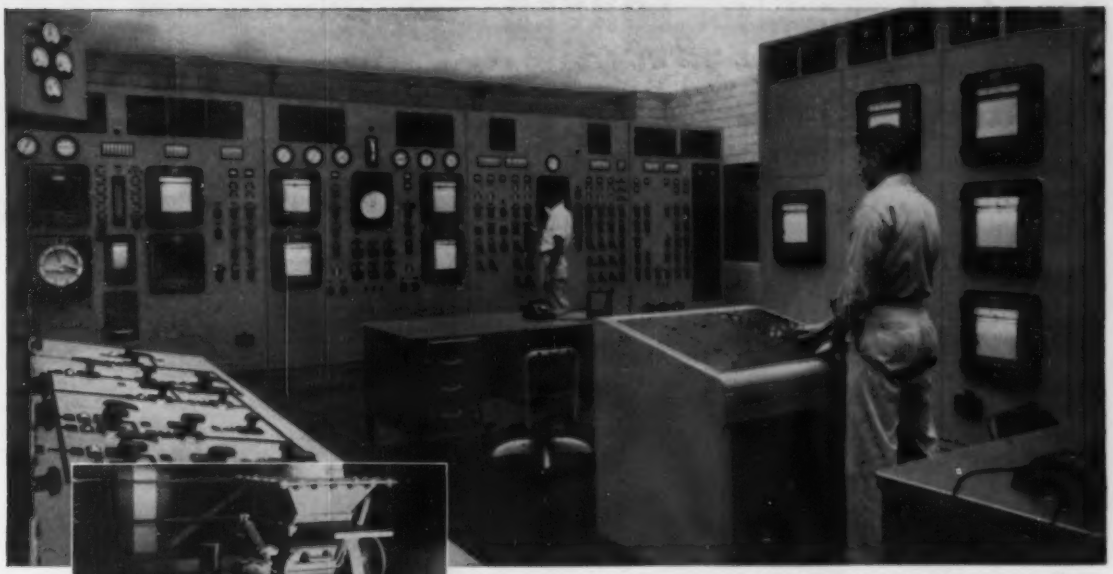
Porous sheets are available in thicknesses from 0.6 to 13 mils and in widths up to 40 in. in a variety of Teflon-to-glass ratios. They are currently being used as interlayer insulation in high-temperature coils and transformers, and as spacers in tantalum electrolytic capacitors. Dissipation factor at 1,000 cps and 25C is 0.002 maximum and volume resistivity is 10^{15} ohm-cm.

American Machine & Foundry Co, 261 Madison Ave, New York 16, N. Y.

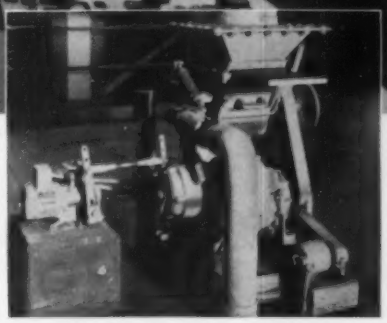
Ultrasonic Drill

A 50 w ultrasonic drill produces a vertical reciprocating action permitting holes of any shape and complexity to be drilled in hard and brittle matemials such as glass, ceramics, germanium, tungsten, titanium carbide, and diamonds. Other machining operations such as shaping, grinding, and polishing are also possible.

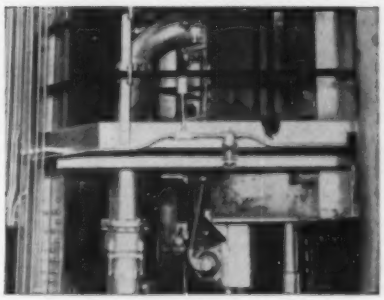
(*Continued on page* 180)



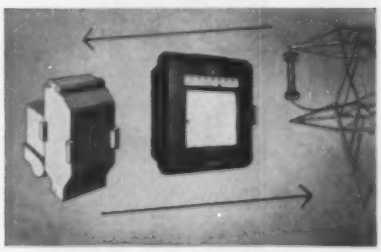
Load-frequency control & panel engineering



Combustion control



Superheat-reheat control



Combustion rate anticipator

In addition to control applications, L&N provides Speedomax® and Micromax® recorders for all power plant temperatures, conductivity, pH, per cent CO_2, O_2, steam purity, smoke, frequency, voltage and current (both AC & DC) power factor, kw, rkva, kva, daylight intensity and humidity.

YES, L&N DOES OFFER THE COMPLETE

coal-to-kilowatt control system...

and you get more than merely undivided responsibility. You benefit dollar-wise from the precision engineering which goes into the design, development and application of every L&N control component. The Speedomax® recorders and controllers used, for example, are the same types of instruments preferred by research laboratories for extremely high precision and reliability.

And of equal importance, when you specify L&N control, you get the benefit of application experience based on the complete power plant problem. For in the past 25 years, L&N Field Engineers have tackled—and solved—instrument engineering problems in every phase of combustion, superheat-reheat, and load-frequency control.

So, if you're thinking in terms of complete, *integrated* control and savings in operating costs for the long haul, look to L&N. Offices in 18 major cities, or 4938 Stenton Ave., Phila. 44, Pa.

LEEDS NORTHRUP
instruments automatic controls • furnaces

Gentle Charging for LONGER Battery Life...

With Control Corporation's

Automatic Battery Chargers

Extend Battery Life for Power Companies from Coast to Coast

Automatic *Controlled* Charging . . . prolongs battery life. Every 60 seconds the automatic control tests the battery and makes a *small* adjustment in charging rate—according to the battery's need. In this way, batteries easily adjust themselves to the new charging rate without gassing, sulphation or unequal build up.

The Control Corporation's automatic charging system is a real battery "lifesaver".

Control Features

Non-Electronic Voltage Regulator . . . No tubes to burn out or replace. The low torque, slow speed motor drives the Variac to control voltages with high efficiency.

Output held within 1% . . . even though line voltage varies up to 10%!

Cells build up evenly . . . under the slow, steady, controlled charging rate.

Lifetime Selenium Rectifiers . . . chosen for their exceptional dependability and long life. Rectifiers are convection cooled and protected thermostatically for utmost dependability.

Top Quality Components . . . each one chosen for its proven service, long life and dependability.

Three Way Protection:

- Overcurrent protection . . . with air type circuit breakers.
- Thermostatic protection . . . another plus safety feature to assure controlled output under abnormal load conditions.
- 1500 volt Hi-Pot . . . gives complete protection and excellent isolation.

Behind the scenes . . .

The heart of the Control Corporation's Automatic Charger which selects the Best charging rate every 60 seconds . . . It's a real battery lifesaver!

Write for details on Control Corporation's complete line of Automatic Controlled Battery Chargers.

CONTROL CORPORATION

719 CENTRAL AVE. N.E. MINNEAPOLIS 14, MINN.

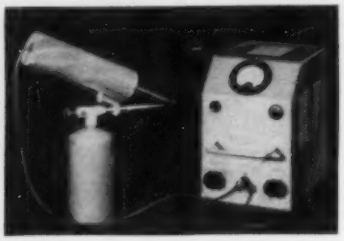
• Super-Trol • Peak-Trol • Telemetering • Battery Chargers • Carrier Current •

New Equipment

(*Continued from page* 178)

The reciprocating action is used with an abrasive slurry and surface finishes of 18 to 20 microinches may be attained, depending on coarseness of the abrasive.

International Electronics Corp, 81 Spring St, New York 12, N. Y.

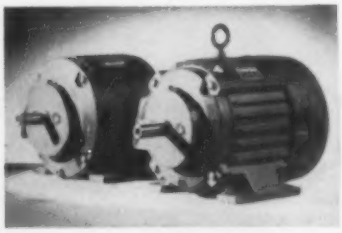


Soldering Iron

Ultrasonic soldering iron makes possible joining of aluminum, magnesium and their alloys without flux or where corrosive fluxes must be avoided. It is useful for soldering metals that form refractory oxides, without tinning or special surface pretreatment, and can also be used for filling voids in aluminum or magnesium castings.

Glennite irons are available in 2 models: Electric heated, U 611; and gas fired, U 610. Both utilize a soldering tip attached to a transducer powered by Model U 600G ultrasonic generator which operates on an input of 35 w.

Vibro-Ceramics Corp, Metuchen, N. J.

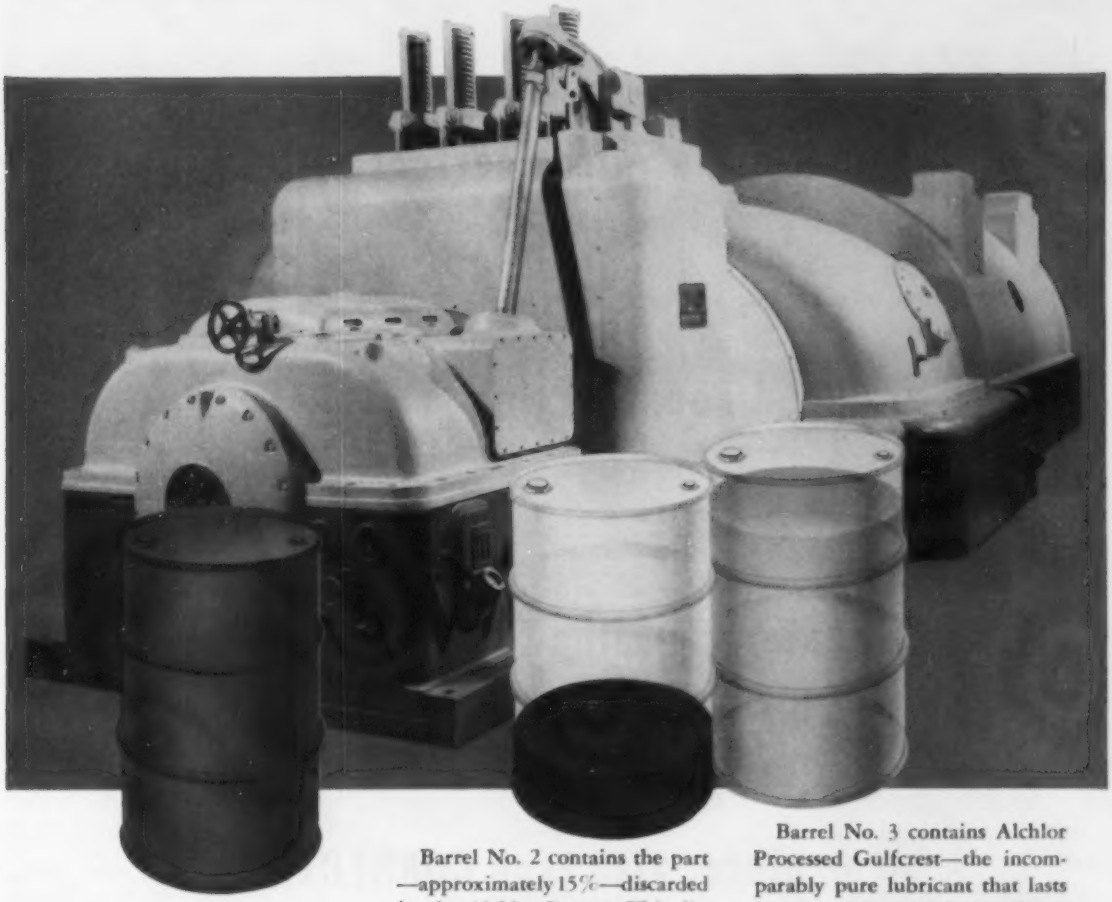


Protected Motors

Protected ac motors offer protection against drip, splash and falling objects regardless of mounting position. This is made possible by ventilation louvers being placed high in

(*Continued on page* 183)

GULFCREST *is the only turbine oil that is super refined for superior performance by the ALCHLOR PROCESS*



Barrel No. 1 contains a highly refined oil that will become Gulfcrest. It has gone through the usual steps used in refining other turbine oils—but has not yet been Alchlor Processed.

Barrel No. 2 contains the part —approximately 15%—discarded by the Alchlor Process. This discarded portion contains unstable hydrocarbons which, if allowed to remain in a turbine oil, are likely to oxidize, increase neutralization number, form sludge, emulsifiers, and harmful acids.

Barrel No. 3 contains Alchlor Processed Gulfcrest—the incomparably pure lubricant that lasts longer, gives superior performance and helps keep your turbine systems clean indefinitely. To make Gulfcrest even finer, special inhibitors are added to give it still greater stability and protect against corrosion and foaming.

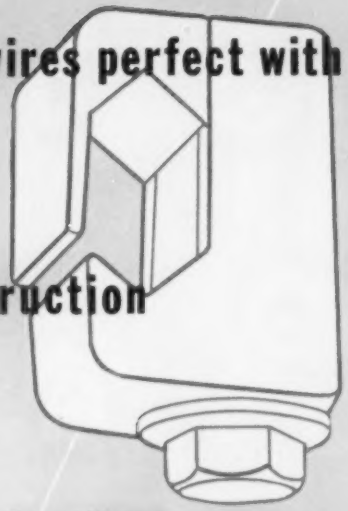
Call your nearest Gulf office today and have a Gulf Sales Engineer recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines.

GULF

GULF OIL CORPORATION • GULF REFINING COMPANY • 1822 Gulf Building, Pittsburgh 30, Pa.

Fast, easy installation

Alignment of wires perfect with "V" jaws



Rugged construction

Greater clamping force, less wrench torque

One piece, vise type CONNECTORS

FARGO

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N.Y.

Distributed by
LINE MATERIAL COMPANY
(A McGraw Electric Company Division)
Milwaukee, Wisconsin

LM

Ask your Line Material Field Engineer for complete details.

New Equipment

(*Continued from page* 180)

the end brackets. Bearing mountings are placed closer to the frame to insure shockproof shaft support. Conduit boxes can be positioned in any of 4 quadrants for ease of installation.

Motors are available in fan-cooled, corrosion-proof and explosion-proof designs.

Reliance Electric & Engineering Co, 1088 Ivanhoe Rd, Cleveland 10, Ohio

Hi-Temperature Cable

An Okotherm-insulated, aluminum-sheathed cable is designed for continuous operation at 150C and up to 200C under certain conditions. It is available for both power and control circuits. Conductors are lead-coated copper ranging in size from No. 19 to No. 6 AWG. Details in Bulletin 1088.

Okonite Co, Passaic, N. J.

Potentiometer

Esipot potentiometer offers the equivalent of a 10 turn potentiometer with less than two revolutions of a single control shaft. The unit consists of a high resolution single turn potentiometer which actuates a ten position attenuator switch as the shaft reaches the end of its travel in either direction. This switch transfers the potentiometer to any one of ten voltage positions provided on a ten step attenuator. Precision fixed resistors in initial attenuator section provide

Pierce

QUALITY BRAND

UTILITY BODIES

• RUGGED • CONVENIENT • QUALITY •

Everything

YOU NEED IN A BODY TO GIVE YOU LOWER COST RESULTS

"SM"—Service Maintenance Bodies 74" to 104" long by 74" to 89" wide. Completely equipped with tool and parts storage for efficient operation.

"LC"—Line Construction Bodies with or without crew compartments. Fabricated for rugged use. Designed for efficient tool and parts storage and built to a high standard.

"CMS"—Combination Meter Service Bodies 74" to 104" long by 74" to 89" wide. Transverse through compartment at front of body for carrying electric or gas meters. Capacity 12 to 36 electric meters or 5 to 16 gas meters. Two small parts drawers with removable dividers.

"SML"—Service Maintenance Ladder Bodies built to carry a ladder of your specifications. Complete with warning system and flashing lights. Compartment installations the same as "SM" Series Bodies.

"PLCC"—Combination Platform and Line Body with crew cab. Bodies of many different custom designs with or without crew cabs. Increases utility use of platform bodies with or without diggers.

"TT"—Transformer Trailer is one design of many for installation of transformer and circuit power. Transformer Trailers provide added capacity to restore service when secondary breakers trip repeatedly or transformers overload. This ingenious arrangement simplifies change-outs with fast service, anywhere.

Write for complete information.

"CPT"—Cargo Pole Trailers of many designs and capacities. Single, dual and four wheel trailers built to your specifications.

We will gladly quote you on any body or trailer design of your specifications.

AUTO BODY WORKS, Inc.

APPLETON • WISCONSIN

Two-Man
COMBINATION TRUCKS
Pay Dividends

With a ¾ or 1-ton truck and Tel-E-Lect "Combination" Body, you can . . .

- Dig holes and set poles up to 40'
- Handle your regular service work
- Reach a variety of jobs quicker
- Operate with two men at less cost

IT'S A COMPLETE PACKAGE, tailored for your make and model of truck. Derrick, winch and digger drive are all assembled to the body, ready for your truck chassis. Easily mounted in a few hours by your local mechanic.

Write for Bulletin

TEL-E-LECT
PRODUCTS, Inc.
10,003 Minnetonka Blvd., Minneapolis 16, Minn.

a wide range of resistance values having excellent frequency response and power dissipation characteristics.

The assembly is 1.75 in. diam x 1.75 in. long behind the panel and mounts in a ⅞ in. hole. Operating shaft is ¼ in. diam.

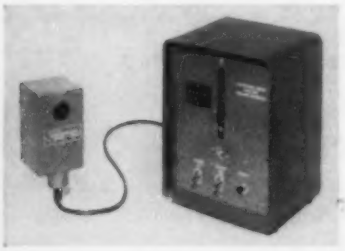
Electro-Measurements, Inc, 4312 S. E. Stark St, Portland 15, Ore.

Radiation Detector

Lightweight portable probe selectively detects alpha-beta-gamma and thermal-neutron radiation. The device features interchangeable heads for detecting different radiation, high thermal neutron counting efficiency, and the ability to count alpha particles in the presence of high beta-gamma background. Fast scanning is possible with the probe because of its sensitivity which is about 25,000 counts/-min/milliroentgen/hr.

Probe output is fed into a preamplifier which operates into almost any scaler.

General Electric Co, Schenectady 5, N. Y.



Electronic Counter

Decade counter is capable of a sustained counting rate of 200 counts per sec. Model 345 features printed circuits and a miniature high-speed mechanical register combined with an electronic decade.

(*Continued on page* 188)

TODAY

...look for the extras!

Standards are guides. They provide power men with basic performance characteristics. But with suspension insulators, **today**, it's the *plus* values that count—that mean *extra* built-in factors of safety—better performance. For instance, at Porcelain Products, standard tests are not enough. We look *beyond* the tests—to craftsmanship . . . research—to individual performance standards of men and the machines they operate.

From clay selection to final shipment, better controls and methods are under constant study. You can *rely* upon Porcelain Products to give you *more* extras—extras that mean "better than standard" performance.

Quality You Can Trust

EXPORT REPRESENTATIVE . . . Philips Export Corporation, 100 E. 42nd Street, New York 17, New York, U. S. A. Cable Address—"PHILYORK"

PP INC.

YOUR INDEPENDENT INSULATOR MANUFACTURER

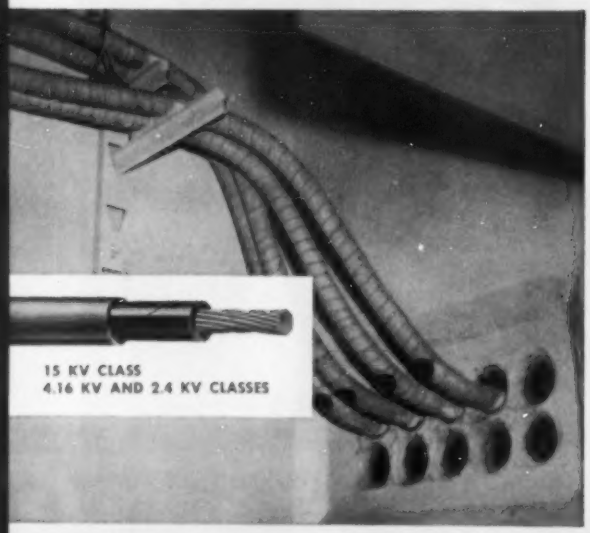
Porcelain Products, Inc.

PARKERSBURG, W. VA.

15 KV CLASS
4.16 KV AND 2.4 KV CLASSES

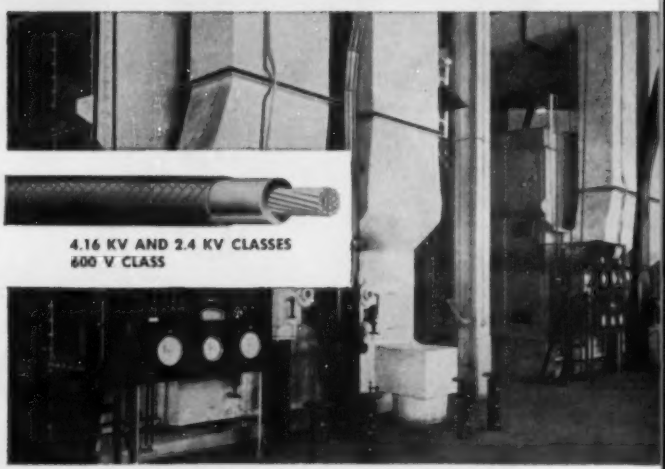
A G-E INTERLOCKED ARMOR CABLE For use above ground. Both indoor and outdoor runs. Cable runs along elevated pipe structure. Supported by racks, trays, or messengers.

V G-E VARNISHED CAMBRIC LEADED CABLE For conventional underground installation. High impulse strength for voltage surges. The lead sheath is impervious to moisture.



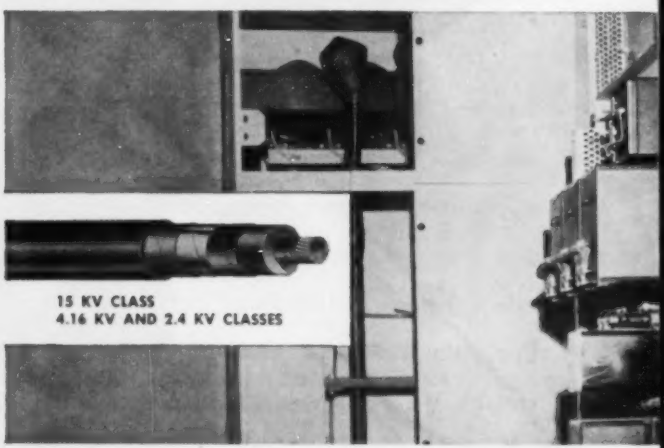
15 KV CLASS
4.16 KV AND 2.4 KV CLASSES

15 KV CLASS
4.16 KV AND 2.4 KV CLASSES



4.16 KV AND 2.4 KV CLASSES
600 V CLASS

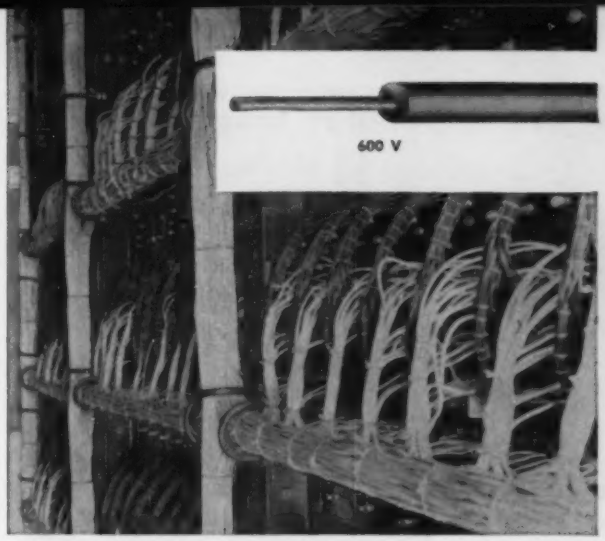
G-E SILICONE RUBBER CABLE For use where high ambient temperatures, high humidity, corrosive vapors and other severe operating conditions exist. Extra reliability in case of nearby fire.



15 KV CLASS
4.16 KV AND 2.4 KV CLASSES

G-E SUPER CORONOL* GEOPRENE* CABLE For underground use. Duct, conduit, and raceway installations, or burying cable directly in the ground. Resists oxidation, ozone, corona, sunshine, water, etc.

G-E PREASSEMBLED AERIAL CABLE Mostly for outdoor runs. Long spans, supported by poles, towers, or buildings.



G-E FLAMENOL* CABLE The ultimate in chemical resistance above or below ground level. Single conductors in ducts, raceways, conduit, or buried.

G-E VERSATOL* GEOPRENE CABLE For cables above or below ground level. Large conductors, heavy loads. Resists moisture and chemicals. Flexible—an all-purpose cable.

TO MEET YOUR NEEDS FOR INCREASED POWER

Select a G-E cable to meet your requirements

Since reliable power supply is a vital factor in any industry, you'll be interested in high-quality cable of the right type for your application. Specify General Electric cable to meet your needs.

POWER CABLES for special or general purpose; for feeder systems, distribution systems, equipment leads and railway, shipboard, and mining applications.

CONTROL CABLES for aircraft wiring, station and communications systems, and appliance and equipment wiring.

For other industrial applications, specify General Electric Cords and Wires

G-E CORDS are available for practically every type of electrical appliance or industrial equipment.

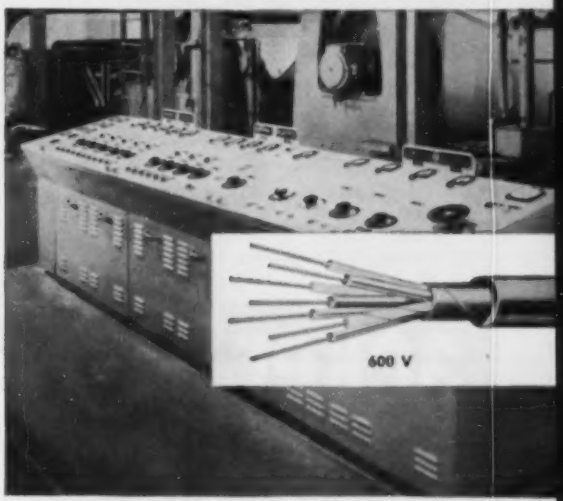
G-E MAGNET WIRE can be furnished to meet every requirement of industry for long-lived and dependable electrical apparatus.

To meet your power requirements, select a General Electric cable, wire, or cord. Write Section W157-427, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-mark General Electric Company

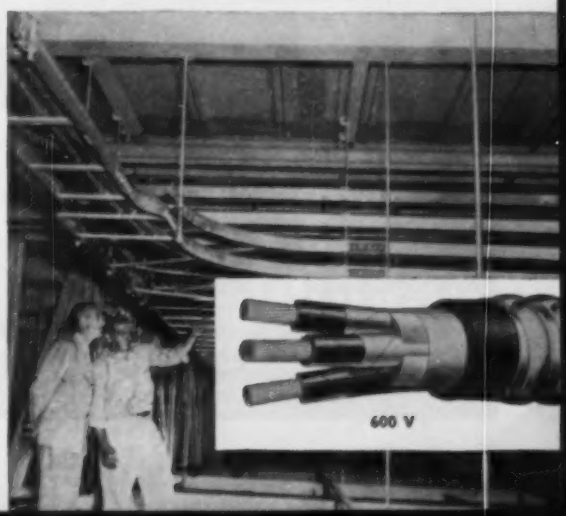
Progress Is Our Most Important Product

GENERAL ELECTRIC



G-E FLAMENOL CONTROL CABLE For important control circuits, switchboard leads, and motor leads. Can be installed in open air, in ducts, or in conduit.

G-E VARNISHED-CAMBRIC FLAMENOL INTERLOCKED ARMOR CABLE For installation above ground. Indoor and outdoor exposures. Resists mechanical abuse.



When lightning strikes this summer . . . record every detail of system behavior with a 12-channel RS-9 Automatic Oscillograph . . . immediate delivery. Hathaway Instrument Company (Division of Hamilton Watch Company), 1315 South Clarkson Street, Denver 10, Colorado. Write for bulletin 2-F1-B.

acker utility digger sets poles in minutes!

The new Acker Utility Digger makes short work of pole setting. Its lightweight, compact design performs perfectly in rugged open country or crowded city streets. The basic unit mounts on jeep or small truck with either self-contained or power take-off.

LOOK at some of the exclusive features of this moderately priced digger.

1. Built-in power hoist and sheave have a capacity of 1500 lbs.
2. High speed auger digs holes up to 20" in diameter and depths of 10 feet.
3. Completely self-contained unit with no extra accessories to buy.
4. Finger-tip hydraulic controls for easy, one man operation.
5. Speedy operation saves time and money.

For complete details, write for bulletin **40EW.**

ACKER DRILL CO., INC. 725 W. Lackawanna Avenue Scranton, Penna.

a complete line of Soil Sampling Tools, Diamond and Shot Core Drills, Drilling Accessories and Equipment

New Equipment

(*Continued from page* 184)

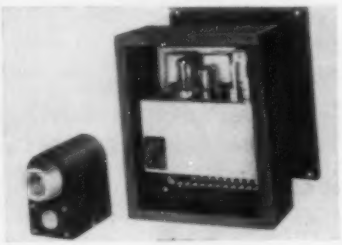
Operating pulses may originate from contact closure or from plug-in photoelectric or magnetic pick-ups. Count capacity is 1,000,000.

Daytronic Corp, 216 S. Main St, Dayton 2, Ohio

Meters

Switchboard meters with 250 deg arc-angle scale are designed to provide extra compactness and ease of reading. The exceptionally long scale and completely new movement are said to make possible unusually accurate readings. Case styling is designed to match other panel instruments in the company's line.

Roller-Smith Corp, Bethlehem, Pa.



Speed Control

Registration control operates continuously over both high and low speed ranges, without special attachments, to maintain accuracy in automatic machine operations on plastics, tin, steel or other sheet material. Photoswitch Control Type 23LF3 Model 1006 responds instantly to the appearance of a mark printed on ma-

TOP OF THE LINE

DEPENDABLE, LIGHTWEIGHT, LIFETIME

ANDERSON

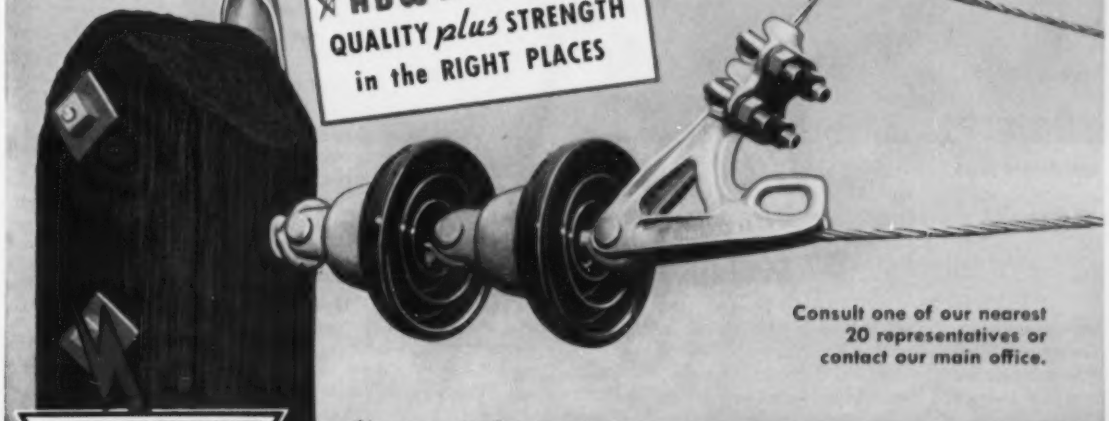
Aluminum CONNECTORS

A TROUBLE-FREE COMBINATION . . LC-81A AND DE-101 . . . WITH ALL THE "BUGS" ENGINEERED OUT! DESIGNED FOR EASY HANDLING AND QUICK, POSITIVE INSTALLATION!

ANDERSON connectors, clamps, fittings and accessories are designed and engineered for strength, durability and high efficiency. ABW products are recognized standards in the industry.

ANDERSON makes "top of the line" handling of power connectors, clamps, fittings and accessories *fumble-proof*, too! Usually just one wrench is the only tool a lineman will need.

☆ **ABW DESIGN MEANS QUALITY *plus* STRENGTH in the RIGHT PLACES**



Consult one of our nearest 20 representatives or contact our main office.

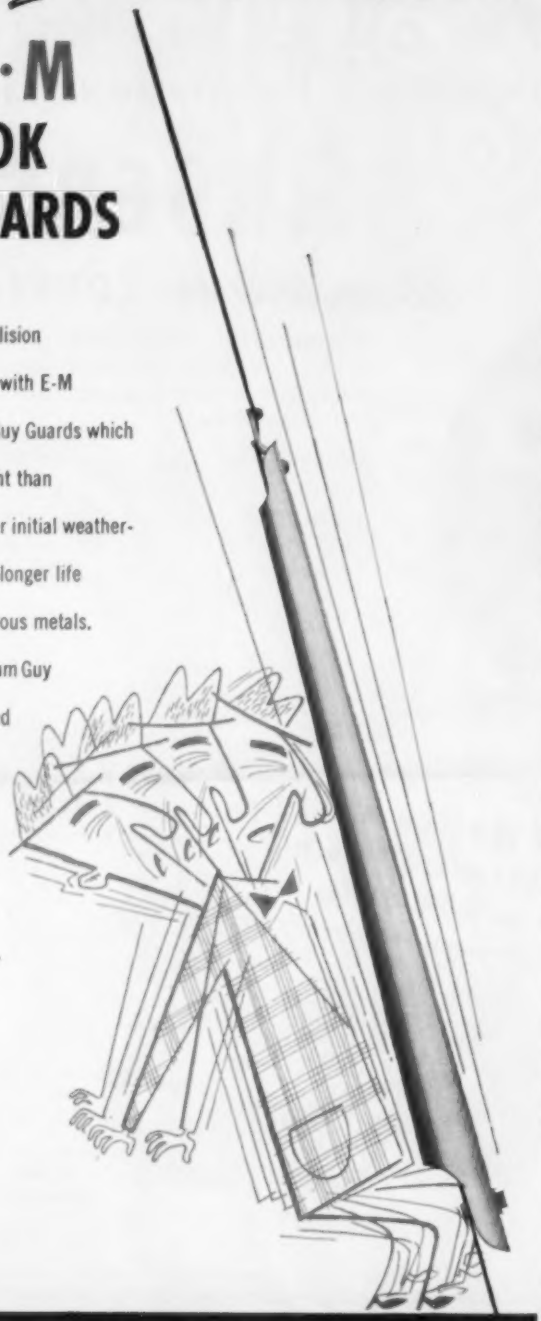
Aluminum & Bronze **POWER CONNECTORS • CLAMPS • FITTINGS • ACCESSORIES for SUBSTATION • TRANSMISSION • DISTRIBUTION SYSTEMS** *for over a Quarter Century*

ANDERSON BRASS WORKS, INC.

P. O. DRAWER 2151 • BIRMINGHAM 1, ALABAMA

this is 1/2 as likely to happen with E·M QUIK-LOK GUY GUARDS

Prevent accidental collision and possible lawsuits with E-M Quik-Lok Aluminum Guy Guards which reflect much more light than galvanized guards after initial weathering. Save, too, on the longer life of aluminum over ferrous metals. E-M Quik-Lok Aluminum Guy Guards can be installed in 60 seconds or less by one man. A sample, our comprehensive new catalog, or a call by our representative is yours for the asking.



Designers and manufacturers of pole-line hardware that saves you time, money and maintenance. Prompt action on special problems. 52

EM

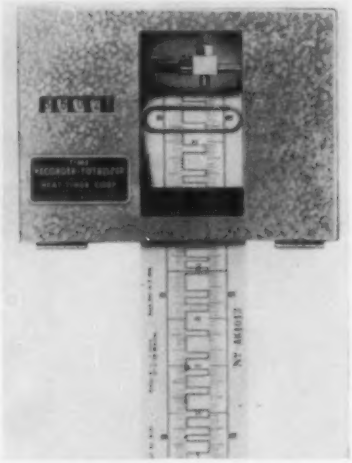
ELECTRICAL MANUFACTURING CO.

BATTLE CREEK, MICHIGAN

terial moving past at speeds from 15 fpm to more than 500 fpm. An abrupt change in light intensity caused by passage of this mark actuates a control relay which triggers speed correction devices.

The unit operates on 115 v, 60 cps and responds to an impulse of less than 0.0005 sec. Ask for Bulletin PD 551.

Electronics Corp. of America, Photoswitch Div, 77 Broadway, Cambridge 42, Mass.



Recorder

Time recorder plus totalizer provides continuous operation record of electrically operated machines or processes. Chronologically marked tape continuously passes through instrument, recording time and length of every "on" and "off" period of equipment. Totalizer gives total of complete "on" time of equipment.

Standard tape speeds are either 1 in. per 5 min, 1 in. per 15 min, or 1 in. per hr. Unit operates on 115/220 v, ac.

Heat-Timer Corp, 657 Broadway, New York 12, N. Y.

Welding Cable

Fluted welding cable is said to have high impact resistance along with long wearing qualities. It is light and flexible, easy to grip, and cooler to handle, since its greater surface area dissipates heat faster than conventional round welding cable.

Jacket is made of 60% natural

DOW

DOW PRODUCTS

GIVE ALL-AROUND BRUSH CONTROL ON RIGHT-OF-WAYS

ESTERON Brush Killer and
ESTERON 245 cut maintenance costs

A "crew" of Dow chemicals, used separately or as a team, will cut your maintenance costs to a new low. Esteron® 245 is highly effective for year-around brush control when used as a foliage spray or for basal bark and stump treatment. Esteron Brush Killer is widely used as a foliage spray for brush control.

In addition, Dow offers two new products to solve specific vegetation control problems. Kuron, new Dow brush killer containing silvex, has shown good results on post oak, blackjack oak, white oak, Northern pin oak and other oak species as well as red and hard maples. Where grass control is desirable in poleyards and around substations, Dow Dalapon Sodium Salt 85%, new *systemic* grass killer, is recommended. It can be used in combination with 2,4-D to control *both* broad-leaved weeds and grass. Ask your supplier how Dow products can cut your maintenance costs and help you get positive weed and brush control. Or write THE DOW CHEMICAL COMPANY, Agricultural Chemical Sales Department, Midland, Michigan. In Canada: Dow Chemical of Canada, Limited, Toronto, Canada.

you can depend on DOW AGRICULTURAL CHEMICALS

DOW

Completely NEW . . . for Electric Utilities

Meter Installation and General Service BODIES

Morrison's new electric utility Service Bodies and Accessories give your trucks a clean, neat appearance . . . provide maximum safety for crew and equipment . . . feature a compact design with more useable carrying space and a time-saving accessibility to tools, parts and supplies.

With models to fit 40 different ½ - ¾ - 1 and 1½-ton, single or dual wheel chassis . . . 18 possible compartment arrangements . . . completely weatherproof compartments . . . and more than 20 other new design and construction features, Morrison Service Bodies are engineered and built to meet the specific requirements of electric utilities, in accordance with their recommended specifications.

Morrison Service Bodies and Accessories can completely equip any truck for any job. For meter installation and service there are Meter Trays for both horizontal and vertical compartments. They are equipped with necessary padding and hold-down straps which clamp the meter securely in place without sacrificing easy access for loading and unloading. Other available optional equipment includes material bins, rope hooks, rear bumper step and sliding top with lockable rear closure. For general service work, either overhead ladder bows or side mount ladder brackets can be installed.

In all phases of utility service work, Morrison Service Bodies and Accessories can help you promote crew efficiency and cut operating costs. Complete information on the entire line is available on request.

For Better Service and Greater Utility . . . Specify

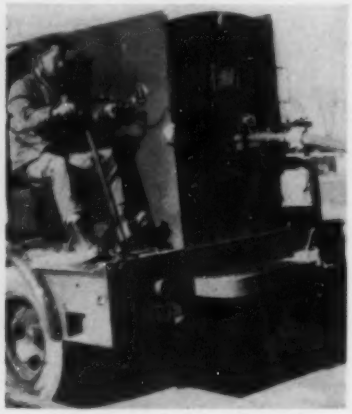
Morrison service bodies

Morrison Service Body Division

MORRISON STEEL PRODUCTS, INC. • 695 Amherst St. • Buffalo 7, N. Y.

Morrison Service Bodies are stocked locally in more than 60 strategic locations

rubber compound with high impact, abrasion and moisture resistance. A reinforcing braid of rayon provides a non-slip bond between jacket and insulation, which is a special natural rubber compound. Conductors are wrapped with insulating paper tape.
United States Rubber Co, Rockefeller Center, New York 20, N. Y.



Duct Rodder

Machine is capable of rodding underground power or telephone ducts to a distance of more than 1,000 ft Series 600 duct rodding machine causes rod to revolve clock-wise in duct as it pays out, returns or holds the rod steady, without shifting gears or stopping.
Petersen Engineering Co, Santa Clara, Calif.

Street Barricade

Rugged, lightweight, utility barricade is made of welded steel tubing and finished with a rust-preventative coating to customers color specifications. It has lantern hooks on both ends and can be joined with similar units for added length.
Utility Service Co, 1620 13th St, Racine, Wis.

(*More New Equipment on page* 194)

WHAT HAPPENS NEXT?

If management has been wise, a fire tragedy will be stopped before it starts...if not, in 20 minutes extensive destruction and total loss could readily be the result.

First-rate fire protection is essential to the continued success of any business. With C-O-TWO Smoke or Heat Fire Detecting Systems, plus C-O-TWO High Pressure or Low Pressure Carbon Dioxide Type Fire Extinguishing Systems, as well as PYRENE Air Foam Type Fire Extinguishing Systems for specific outdoor locations, your plant can have fast, positive round-the-clock fire watchman service simultaneously at each fire hazard point . . . a fire tragedy is stopped before it starts.

Furthermore, there is a personal sense of responsibility inherent with PYRENE—C-O-TWO Fire Protection Engineers that assures you of fully adequate firesafety . . . a definite plus in your behalf. Whether it's fire detecting or fire extinguishing . . . portables or built-in systems . . . PYRENE—C-O-TWO means top quality backed by experienced engineering that results in operating superiority for you at all times.

Act now . . . don't take unnecessary chances with your investment any longer . . . the extensive experience of PYRENE—C-O-TWO over the years is at your disposal without obligation. Remember . . . a plant-wide fire protection survey skillfully executed today could be the means for greater profits tomorrow.

Pyrene

PYRENE — C-O-TWO

NEWARK 1 • NEW JERSEY

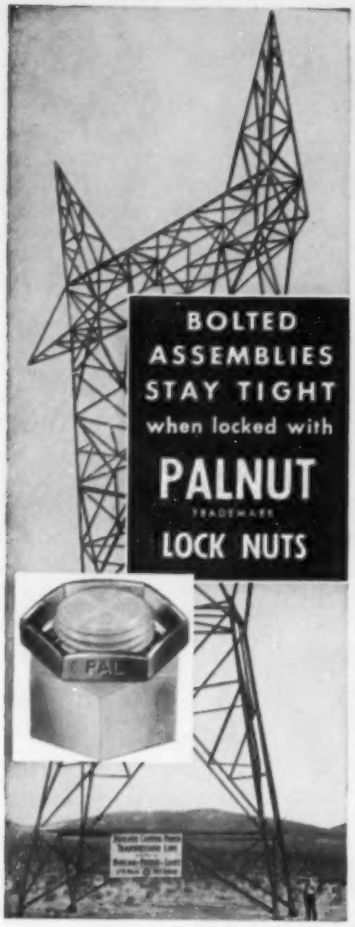
Sales and Service in the Principal Cities of United States and Canada

C-O-TWO

COMPLETE FIRE PROTECTION

portable fire extinguishers . . . built-in fire detecting and fire extinguishing systems

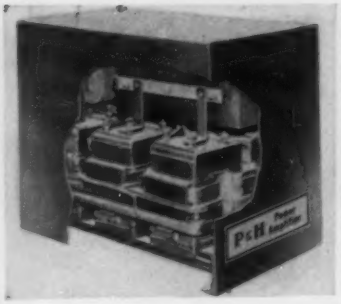
CARBON DIOXIDE • DRY CHEMICAL • VAPORIZING LIQUID • SODA-ACID • WATER • CHEMICAL FOAM • AIR FOAM



Specify PALNUTS on new lines . . . add PALNUTS to existing lines, to eliminate further re-checking and re-tightening of bolts. PALNUT Locknuts are the lowest cost, most dependable method of locking steel tower bolts. Once tightened, their double locking spring action holds tight under severest vibration. PALNUTS are extremely low in cost, require only three bolt threads, apply fast, may be removed and reused. Hot Dip Galvanized and other finishes and materials used by utility industry. Free samples on request.

The PALNUT Co.
51 Cordier St.
Irvington 11,
New Jersey

PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost



Motor Control

Non-rotating source of dc power provides variable speed, stepless motor control. P&H power amplifier operates on any input phase and voltage combination. It is designed around transformers, saturable reactors, and rectifiers and is a fully self-contained unit. Control is achieved by a rheostat or any other variable device.

Amplifier is built in a range of sizes from 1 to 30 hp and can supply one or more motors up to total of its capacity.

Electrical Products Div, Harnischfeger Corp, 4621 W. National Ave, Milwaukee, Wis.

Cable

All-purpose cable can be used for underground wiring—including direct burial—feeders, and branch circuits. Cliftall UF cable can also be used either exposed or concealed in dry, wet or corrosive areas, in masonry block, or imbedded in plaster.

Copper conductors are insulated with thermoplastic and then covered with reinforced fiber glass. Parallel conductors are sealed as a unit in thermoplastic. Cable is available in sizes 14 to 4 AWG, single conductor; 14 to 10, two conductor, with or without ground; and 14 to 10, three conductor, without ground.

Clifton Conduit Co, Inc, 75 Montgomery St, Jersey City 2, N. J.

(*More New Products on page* 196)

DO YOU HAVE A TWO-STAGE PRESSURE OR TEMPERATURE CONTROL PROBLEM

MERCOID® HAS THE SOLUTION

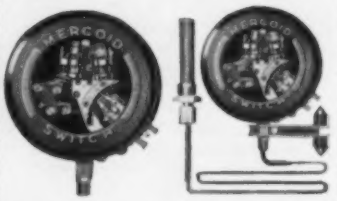
Mercoid DA-400 Series Controls are dual purpose controls (available for pressure or temperature) incorporating a single element operating two separate independently adjustable Mercoid magnetic mercury switches. Circuit arrangements can be supplied for various operations, a few examples are:

1. Close one alarm circuit at high setting and a separate circuit at low setting. Both circuits remain open between the high and low operating points of the two switches.

2. As an electrical interlock to open one circuit on a rise above, and the second circuit on a drop below the set operating point.

3. To provide two-stage control by opening one circuit on a rise and a second circuit on a further rise.

***Pressure types* available in 17 different operating ranges from 0-30" vac. to 300-2500 psi. *Temperature types* available in 11 operating ranges from -30-60°F. to 370-530°F.**



All types are equipped with external adjustments and visible calibrated dial.

Our engineers are at your service—send in your control problem or
WRITE FOR BULLETIN CA-PT

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.

ROEBLING PAPER POWER CABLE WITH TELLURIUM LEAD ALLOY SHEATH

YOU WANT

- *EXTRA FATIGUE RESISTANCE,*

PLUS

- *LOWEST LONG-TIME CREEP RATE,*
- *HIGH BURSTING STRENGTH,*
- *TOP STABILITY UNDER HEAT,*
- *ABOLITION OF FREQUENT STOP JOINTS OR REINFORCED LEAD SHEATH,*
- *ABOLITION OF NEED FOR GENEROUS EXPANSION BENDS OR LARGE MANHOLES...*
- *THE DEPENDABILITY ASSURED BY OUR EXCLUSIVE MANUFACTURING, TESTING AND FIELD EXPERIENCE...*

IN SHORT,

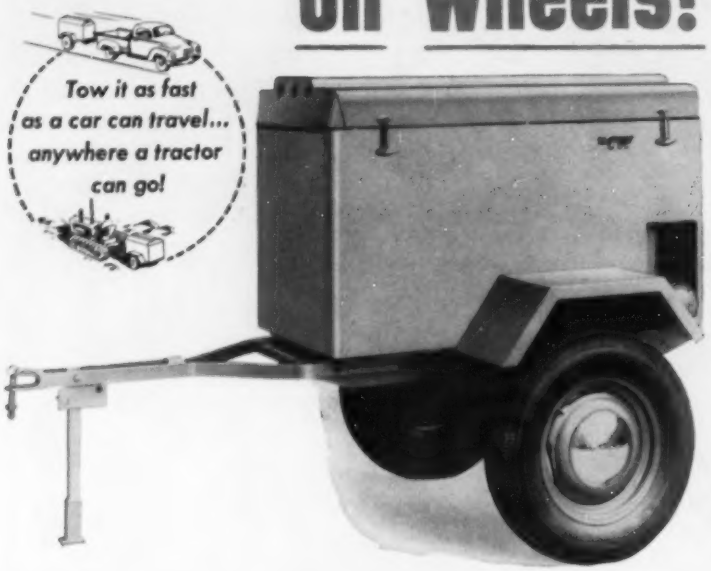
YOU WANT

ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 13229 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5348 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

NEW Powerhouse on wheels!



Trailer-mounted 5 or 10KW

ONAN Electric Plant!

More plug-in power for construction work . . . higher mobility for emergency standby applications! On contracting jobs where high-line power is not available, the Onan "CW" gives you abundant power for all your electric tools, equipment and lights. Now you can use one unit (in place of several smaller portable plants) reducing servicing time and maintenance costs.

Onan "CW" Electric Plants are unusually compact, quiet-running and economical to operate: weigh only half as much as water-cooled plants of the same capacity. Powered by Onan two-cylinder, suction-air-cooled gasoline engines built with massive, long-wearing parts for continuous, heavy-duty service. Fully-protected by heavy-gauge steel housing; stay on the job in any weather.

Wide range of accessories make the "CW" more versatile

You can equip your "CW" Electric Plants for any type of portable service with a wide range of accessories including skid, battery rack, 9-gallon fuel tank, weather-proof housing, two-wheel trailer, or 4-wheel, rubber-tired dolly. *Put one of these portable, high-capacity units on your job now!*

Onan builds electric plants for every need—400 to 100,000 watts

Write for folder A-362

Onan ELECTRIC PLANTS

D. W. ONAN & SONS INC.

2841 University Ave. S. E. • Minneapolis 14, Minnesota

MORE NEW PRODUCTS
about which you should know

Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa., has:

Flexible **neoprene caps** that attach over unshrouded pushbuttons for protection against dust, ice or snow.

A "Select-O-Push" **operator** with double-pole contact block to replace two spdt units. Circuit to be energized is selected by dialing operator head left or right. A pushbutton closes the circuit.

Lever operator for two-unit pushbutton stations to permit precise operation through heavy gloves.

Bus duct with aluminum bus bars in ratings from 225 to 4,000 amp. Joints are double silver-coated for low contact resistance.

Ansul Chemical Co, Marinette, Wisc., has a device which indicates presence of moisture in **refrigeration systems** and then removes it.

Edwin F. Guth Co, 2615 Washington Ave, St. Louis 3, Mo., has a **low-brightness louver** for use with recessed troffers. It is made of No. 1 reflector aluminum and is available for 2-40 w conventional, rapid-start and slimline operation or for 2-75 w slimline.

Librascope, Inc, 808 Western Ave, Glendale, Calif., offers a **magnetic amplifier** for control of large power devices where efficiency and standby power considerations are paramount. The constrained bridge unit operates on 115 v, 400 cps and consumes 3.5 w at full output.

I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Philadelphia 30, Pa., offers encapsulated, precision **wire-wound resistors** in any shape or size specified. Potted resistor networks are solid, hermetically sealed, light weight, fungus-proof, non-conductive, and non-corrosive. They have an ambient operating temperature up to 150C.

Spencer Mfg. Co, 3253 N. Cicero Ave, Chicago 41, Ill., offers a **counter** which will count or subtract at a rate of 400 counts per min, up or down, in any sequence, one count per pulse, max. 999. Coils are for intermittent duty on 6-110 v ac . . . Ideal Industries, Inc, Sycamore, Ill., has

. . . One leading public utility has a 4,500 psi, 1,150F double reheat cycle unit under construction. Another announced plans for a new supercritical pressure, steam electric station. The single-boiler-turbine-generator unit for this new station will operate at a higher steam temperature and pressure, and will have a capability greater than any installation thus far announced. Using supercritical pressure, and employing two stages of reheat, the new unit should be the most efficient plant thus far projected by the central station industry. The 6,000 psi steam generator will supply steam to the turbine at 5,000 psi, 1,200F. . . .

AS POWER PIPING BECOMES MORE CRITICAL

M. W. KELLOGG TESTING TECHNIQUES KEEP PACE

To meet the demand for more electric power, and to increase output with the least possible increase in fuel, the trend in utility steam power plants, as reported everywhere, is to higher temperatures and pressures. Thus steam piping—main and reheat—becomes even more critical than before.

One way in which The M. W. Kellogg Company, leading fabricator of power piping, keeps pace with increases in temperature, pressure, and capacity demands is in its testing techniques. Most recent Kellogg development is the company's "atomic camera". Activated by isotopes such as cobalt, iridium, and cesium, this powerful and portable device can photograph welded seams up to six inches thick in a single, short exposure. The same test by traditional X-ray equipment would take considerably longer.

The M. W. Kellogg Company was among the first to be permitted by the AEC to use isotopes of this magnitude. The atomic camera has already proved its value in the construction of many important public utility jobs. It is indicative of the Kellogg research and engineering which guard the vital link between steam power plant boilers and turbines.

M. W. KELLOGG'S "ATOMIC CAMERA"

FABRICATED PRODUCTS DIVISION
THE M. W. KELLOGG COMPANY, 225 BROADWAY, NEW YORK 7, N. Y.
The Canadian Kellogg Company, Ltd., Toronto • Kellogg International Corp., London
SUBSIDIARIES OF PULLMAN INCORPORATED

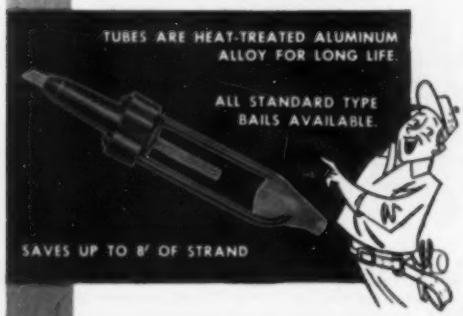
POWER PIPING—THE VITAL LINK

STRANDVISE®

THE SELF-ACTING SELF-CONTAINED TOOL FOR TERMINATING STRAND

Wherever strand is to be terminated, STRANDVISE provides a means that is unmatched for speed and versatility. Many Utilities now know what STRANDVISE does for their pocketbooks.

STRANDVISE makes it possible to install guy wires without waste of time or strand, to terminate suspension strand or ground wire quickly and easily. STRANDVISE, equipped with a new 18" flexible bail, simplifies "false dead-ending" (slack span construction).



STRANDVISE grips surely yet permits easy accomplishment of desired tension or later adjustment to take up slack in strand.

Write for sample STRANDVISE so you may see for yourself its many advantages.

Reliable ELECTRIC COMPANY 3145 Carroll Avenue Chicago 12, Illinois

Over 45 years of service to the utilities

POWER LINE CONNECTORS AND CONSTRUCTION SPECIALTIES

crimp connectors with "Wrap-Cap" insulators to facilitate splicing. Cap is a flexible vinyl material.

B. F. Goodrich Co, Akron, Ohio, has a mildew-resisting, **waterproofing material** called Superseal which is applied to fire hose jackets. It provides increased hose life and maintains hose flexibility in below-freezing temperatures.

Kneisley Electric Co, Toledo 3, Ohio, offers a portable electric **immersion heater** for water and other liquids. Heating coils of the Super Shokless are double sealed in a welded copper jacket so no water can touch heating element. It plugs into 110 v, ac or dc, and is rated 1,000 w.

Alpha Wire Corp, 430 Broadway, New York 13, N. Y., has extruded plastic tubing, impregnated **tubing and sleeving** (fiberglass or organic base), high temperature fiberglass sleeving, plastic coated fiberglass tubing and sleeving, silicone impregnated fiberglass sleeving, and silicone rubber coated fiberglass tubing.

Miller Fluid Power Co, 2040 N. Hawthorne Ave, Melrose Park, Ill., offers continuous-action, automatically reciprocating **air-hydraulic booster** capable of delivering an unlimited amount of high pressure fluid for operation of hydraulic cylinders. It is available in ratios to give pressures of 10,000 psi and over.

Clary Multiplier Corp, Technical Sales Dept, San Gabriel, Calif., has a 10-key **digital read-out machine** for printing data in electrical pulse form. It is available in 4 basic models: Models 1902 and 1903, 8- and 10-column printers; models 1972 and 1973, 8- and 10-column printers with credit balance accumulator.

Lear, Inc, Lear-Romec Div, Elyria, Ohio, offers Series RG-108000 portable or stationary electric driven **pumps** for use in barrels containing fuel, oil, alcohol and other hydrocarbon fluids. Capacity is 9 gpm at 3 psi discharge. Motor is 1/6 hp, 115 v, 60 cps.

Automatic Switch Co, Orange, N. J., has a direct lift, **solenoid-operated, packless valve** designed for low pressure application up to 7 psi. It operates on 10 w and is available in ⅜ and ½ in. pipe sizes.

CATALOGS • BULLETINS

● **EQUIPMENT PLANS:** A 32-page booklet entitled "Electrical Equipment You Can Build" contains detailed plans for more than 50 pieces of equipment that can be built and used around the home or on the farm. Westinghouse Farm Youth Activities, Box 2278, Pittsburgh 30, Pa.

● **LOAD CENTERS:** A 12-page bulletin, GEC-1309, contains information on features and applications of load centers, circuit breakers, and accessories. It includes data on ratings, specifications, wiring diagrams, and dimensions for load centers. General Electric Co, Trumbull Components Dept, Plainville, Conn.

● **CABLE:** Bulletin 1090, 32 pages, describes rubber-insulated Loxarmor cable for use in racks or trays. Current carrying capacities, dimensions, installation and handling techniques, splicing and terminating drawings, and instructions and fittings are included. Okonite Co, Passaic, N. J.

● **AUTOTRANSFORMERS:** Bulletin N, 15 pages, gives construction features, ratings and dimensions of Variac continuously-adjustable autotransformers rated 115 and 230 v. General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.

● **DISTRIBUTION SYSTEMS:** A pocket-size check-list contains nearly 40 check points designed to reveal weaknesses or inadequacies in plant electrical systems. Continental Electric Equip. Co, Box 1055, Cincinnati 1, Ohio

● **SILICONE GREASE:** A 6-page brochure describes applications and performance of 41 Grease, a silicone fluid-carbon black mixture designed for high temperature, slow speed bearings. Dow Corning Corp, Midland, Mich.

● **HYDRAULIC PUMP:** Bulletin DP350, 4 pages, describes high pressure, variable delivery hydraulic pumps designed to generate continuous duty pressures up to 5,000 psi and deliver 4.0 gpm at 2,000 rpm and full rated pressure. Dudco Div, New York Air Brake Co, 1700 E. Nine Mile Rd, Hazel Pk, Mich.

● **RELAYS:** A 72-page catalog gives physical and electrical characteristics of basic type relays. Operating data and applications are included along with definitions of engineering and electrical terms and laws. Guardian Electric Mfg. Co, 1621 W. Walnut St, Chicago 12, Ill.

● **DIESELS:** Bulletin No. S-500-B52B, 7 pages, explains operation of Diesel engines using various fuels and illustrates 5, 6, 7, and 8 cylinder engines in ratings from 550 to 2,200 hp. Charts show fuel cost curves for four fuel systems. Worthington Corp, Adv. & Sales Prom. Dept, Harrison, N. J.

● **CONNECTORS:** Bulletin 38-E (about 170 pages) gives construction features, ratings and applications of a complete line of power connectors. A technical data section contains a wealth of information about properties of various copper and aluminum conductor shapes, forces on bus due to short circuit currents and temperature rise of various conductors. Delta-Star Electric Div, H. K. Porter Co, Inc, 2437 Fulton St, Chicago 12, Ill.

● **WEIGHT SELECTION:** A proportioning system that permits remote dialing of individual ingredient weights is illustrated and described in Bulletin 0351 (28 pages). Richardson Scale Co, Van Houten Ave, Clifton, N. J.

● **AIR DEHYDRATOR:** Bulletin C-5154 (1 page) describes a compressed air dehydrator designed for small volumes of compressed air serving liquid level indi-

STRANDLINK®

THE SELF-ACTING SELF-CONTAINED TOOL FOR SPLICING STRAND

Wherever strand is used, whether for ground wire, suspension strand, down guys or anything else, STRANDLINK is the most economical means for splicing.

STRANDLINK makes the splicing of any grade or size strand simple and easy yet safe and sure. The exclusive Reliable Pilot Cup caps and guides the strand to its proper position. Nuts, bolts, hardware and johnny balls are eliminated. STRANDLINK costs much less than alternate pieces of hardware before installing time is even taken into account.

Hundreds of case-hardened, plated steel teeth in each gripping chuck HOLD firmly and permanently. Assembly is factory treated with corrosion inhibitor lubricant.

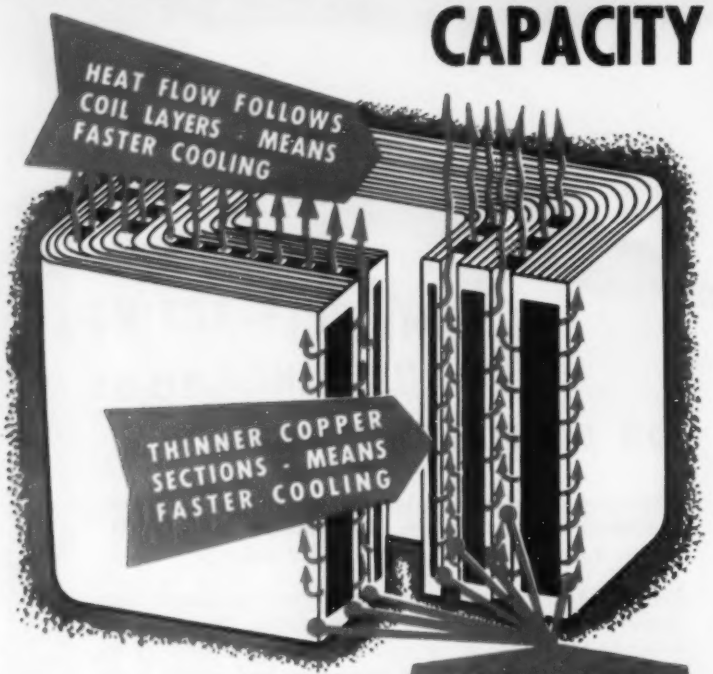
Ask on your company letterhead for a sample STRANDLINK; it will be sent promptly without charge.

JAWS OF GRIPPING CHUCK SURROUND STRAND TO HOLD PERMANENTLY
PILOT CUP IN NOSE GUIDES STRAND THROUGH
MADE FOR ¼" TO ⅝" STRAND

Reliable ELECTRIC COMPANY 3143 Carroll Avenue Chicago 12, Illinois

POWER LINE CONNECTORS AND CONSTRUCTION SPECIALTIES

R T & E transformers have RESERVE OVERLOAD CAPACITY


HEAT FLOW FOLLOWS COIL LAYERS - MEANS FASTER COOLING
THINNER COPPER SECTIONS - MEANS FASTER COOLING
MORE COOLING SURFACES - MEANS FASTER COOLING

"LAYER HEAT CONDUCTION" PROVIDES BETTER HEAT TRANSFER . . . . .

Through extensive research in the study of heat transfer, R T & E engineers have developed a location of oil ducts which more readily conduct heat out of the transformer coil and into the cooling oil. R T & E's oil ducting is based on the principle of "LAYER HEAT CONDUCTION"—that heat generated inside the coils due to inherent copper loss will travel more efficiently around a coil layer than through layer insulation.

Therefore, R T & E's use of more but smaller oil ducts placed at single points adjacent to each layer tends to transfer heat more quickly out of the coil than do the large more sparsely located oil ducts so common in the transformer industry.

This major R T & E development results in reduced coil temperature, the elimination of hot spots, greater overload capacity and longer transformer life.

With "Layer Heat Conduction", R T & E transformers are able to carry loads of 150% for 8 hours without exceeding class A insulation temperature limits.

WRITE FOR CATALOG

R T & E Co.

WAUKESHA WISCONSIN

cators, purge assemblies, remote control installations and for dead-end service applications. Hankison Corp, 163 Biltmore Bldg, 951 Banksville Rd, Pittsburgh 16, Pa.

● **FLOW METER:** Bulletin No. 116, 20 pages, gives construction and safety features, flow capacity charts, dimension drawings, and design data of flow measurement and control meters. Brooks Rotameter Co, Lansdale, Pa.

● **TEMPERATURE:** Bulletin No. 42 contains applications and ratings of indicating temperature controls. United Electric Controls Co, 85 School St, Watertown 72, Mass.

● **MONITOR:** A 23-page catalog describes and illustrates components, operation and applications of a supervisory device for remote monitoring of electric transmission and distribution systems. Sprague Electric Co, Modine Div, Marshall St, North Adams, Mass.

● **VALVE CONTROL:** Catalog L-54, 21 pages, describes and illustrates Limi-Torque SMA valve control for large or small valves. Operating details are included. Philadelphia Gear Works, Philadelphia, Pa.

● **LUBRICATION:** Bulletin No. 16 describes applications and fittings of centralized lubrication systems for small machines or equipment with a limited number of bearings. Farvel Corp, 3249 E. 8th St, Cleveland, Ohio

● **FOAMGLAS PANELS:** A 12-page brochure entitled "Foamglas in Thin Wall & Sandwich Panel Construction" describes advantages of cellular glass insulation for this type construction. Photographs and details of projects utilizing this technique are included along with typical installation details. Pittsburgh Corning Corp, 1 Gateway Center, Pittsburgh 22, Pa.

● **SAFETY EQUIPMENT:** "Everything in Safety" is the title of a catalog (130 pages) of personal protective equipment and industrial safety devices. General Scientific Equip. Co, 2700 W. Huntingdon St, Philadelphia 32, Pa.

● **TRANSDUCER:** A 2-page brochure describes a dual element pressure transducer that translates static and dynamic air pressures to equivalent voltages. Technology Instrument Corp, 531 Main St, Acton, Mass.

● **CABLE:** Publication No. 19-294, 15 pages, contains specification data on general type of street lighting cables for direct burial, and for use in conduit, duct or open-air as well as for cables for overhead lines to luminaires and from pole bases to luminaires. Splicing and terminating methods for cables with various types of insulation are included. General Electric Co, Bridgeport 2, Conn.

● **OIL SWITCH:** Bulletin 71B6101B, 2 pages, gives design, construction features and general dimensions of 3-pole nonautomatic subway oil switches. Allis-Chalmers Mfg. Co, 932 S. 70th St, Milwaukee, Wis.

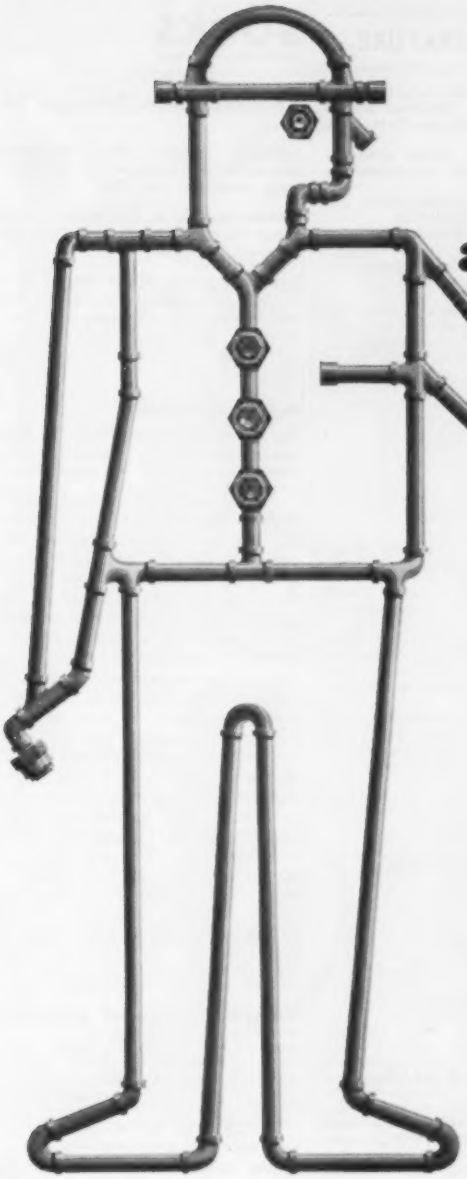
● **MOTORS:** Bulletin No. 1868 illustrates vertical solid shaft motors in ratings from ¼ to 400 hp in grease and oil lubricated types. It also describes footless horizontal motors for direct connection in ratings from ¼ to 75 hp. U. S. Electrical Motors Inc, Box 2058, Los Angeles 54, Calif.

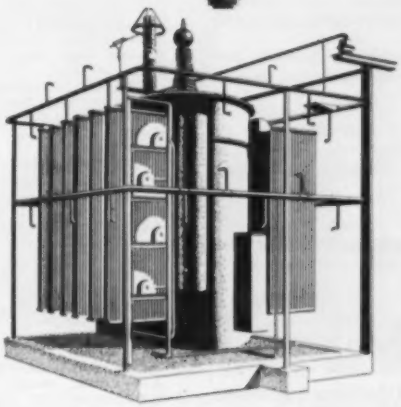
● **AIRTUBE:** A 4-page booklet describes a prefabricated airtube system for connecting any 2 points up to 130 ft apart at either the same or different floor levels. Lamson Corp, Syracuse 1, N. Y.

● **WELDING:** A 36-page catalog (form ADC 848) contains descriptions and specifications for a complete line of arcwelding and oxyacetylene welding supplies and accessories. Air Reduction Sales Co, 60 E. 42nd St, New York 17, N. Y.

engineered by Blaw-Knox...

a 24-hour fire guard





Blaw-Knox fire protection systems carry approvals of all insurance underwriters.

Deluge Systems • Wet Pipe Systems • Dry Pipe Systems • Water Spray and Fog Systems • Rate-of-Rise Sprinkler Systems • Foam and Carbon Dioxide Extinguisher Systems

Blaw-Knox Automatic Fog Systems, engineered to your special hazards, are fire guards that work for you 24 hours a day, every day in the year.

If fire strikes, your Blaw-Knox fire protection system will:

- **smother flames and dissipate heat**
- **protect adjacent equipment**
- **prevent plant destruction and loss of revenue**
- **prevent service interruption**
- **avoid customer complaints**

Let Blaw-Knox engineers study your fire protection requirements. They will submit a layout and cost estimate, at no obligation. Why not call us today.

Send for a copy of our booklet, *Fire Can Destroy Your Business.* You'll find it full of interesting facts.

"Little Joey Sprinkler" always on the job

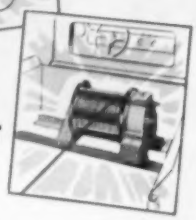
BLAW-KNOX COMPANY

Automatic Sprinkler Department / Pittsburgh 33, Pa.

Only Gar Wood gives

BIG WINCH SAFETY and dependability

for light utility trucks



Choice of standard or low-mount

Compare these features!

Here are 6 reasons why the new 7000-lb. Gar Wood winch will outperform any other winch in its class:

- Exclusive aluminum housing permits lighter weight, faster dissipation of heat.
- Fully enclosed non-slip clutch assures unequalled free control at all times. No sticking! No rusting! No freezing!
- Built-in rope clamp gives better spooling, simplifies attaching and changing of rope, ends danger of rope snagging.
- Self-energizing safety brake automatically stops and holds any load you can handle.
- Self-contained ball-bearing mounted worm shaft assures smoother operation, needs no adjustment.
- Extra rugged base angles guarantee safety many times rated capacity of winch.

GAR WOOD *Winches*

GW-W.2

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Gar Wood Industries, Inc.
Main St., Wayne, Michigan

☐ Send free literature on new 7000-lb. Gar Wood Winch

☐ Std. Mount ☐ Low Mount

Name .....

Title .....

Company .....

Address .....

TECHNICAL LITERATURE

NEMA STANDARDS—The following are available from National Electrical Manufatcurers Assn, 155 E. 44th St, New York 17, N. Y.:

BU 1-1955 Busways, covers products for distribution of power not exceeding 750 v. Price $2.25

MG 1-1955 Motors and Generators, supersedes MG 1-1949. Price $9.50

SG 5-1955 Switchgear Assemblies. Price $4.00

ST 1-1955 Specialty Transformers, supersedes No. 45-98. Price $4.00

TRANSFORMER CONNECTIONS — "Power and Lighting Hook-ups" contains wiring diagrams and descriptions of some of the more common single phase transformer connections used in normal operations. Also included are examples of other typical connections demonstrating the importance of open Delta or Wye "hook-ups" during emergencies when it is necessary to maintain continuous service in spite of transformer failure. The article concludes with schematics of both Scott and booster connections. Kuhlman Electric Co, Bay City, Mich.

AIEE—Following are available from American Institute of Electrical Engineers, 33 W. 39th St, New York 18, N. Y.:

AIEE 505 Proposed Test Code for Power Factor Testing of Power Transformers, 4 pages.

AIEE 954 Application Guide for: Ground-Fault Neutralizers; Grounding of Synchronous Generator Systems; and Neutral Grounding of Transmission Systems, 36 pages.

ASA C37.20 Switchgear Assemblies and Metal-Enclosed Bus. 12 pages. Price 60¢.

ASA C50.20 Test Code for Polyphase Induction Motors and Generators, 20 pages. Price 80¢.

ASA C37.4a and C57.12b (1 sheet) Electrical and Mechanical Characteristics of Apparatus Bushings. Price 25¢

ASA—The 1955 edition (48 pages) of the list of American Standards contains indexes and prices of 1500 standards covering a wide range of fields from engineering and metallurgy to household appliances and furnishings. American Standards Association, 70 E. 45th St., New York 17, N. Y.

TRANSFORMER PROTECTION FILM—A 35-mm sound film strip, "Kilowatt Insurance" explains basic theories of transformer protection against lightning, short-circuits and overloads. It diagrams various methods of protecting transformers and interconnecting devices and points out transformer design characteristics to meet service conditions. Available for engineering and utility training groups from the motion picture section, Allis-Chalmers Mfg. Co. General Machinery Div, Milwaukee 1, Wis.

ELECTRIC HEATING GUIDE—Booklet B-3768, 32 pages, contains information on designing, cost estimating, and installing electric heating systems. It includes sections on heating fundamentals, factors involved in cost estimating, installation of heaters, planning adequate wiring and proper circuit protection, and weather data. Price $2 Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.

WATER CONDITIONING — "Handbook on Demineralizing" is the title of a 40-page book which compares various methods of water treatment and indicates the comparison between demineralizers and evaporators. It goes into characteristics of types of available cation and anion exchange materials and offers data on operating costs of demineralizing. Ask for Publication 5800-B. Cochrane Corp, 17 & Allegheny Ave's, Philadelphia 32, Pa.

BOOKS

Received Since February 14.

Electricity. By Eric De Ville. Published by Penguin Books Inc. Baltimore 11, Maryland. 159 pages, illustrated. Price $.65.

Starkstromtechnik. By E. V. Rziha. Published by Verlag Von Wilhelm Ernst & Sohn, Berlin, Germany. 279 pages, illustrated.

Elements of Servomechanism Theory. By George J. Thaler. Published by McGraw-Hill Book Co, New York 36, N. Y. 282 pages, illustrated. Price $7.50.

Fast Depreciation

New Rapid Tax Depreciation. **By Willard F. Stanley. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11. 153 pages. Price $15.00.**

All factors of new rapid tax depreciation are covered; not merely the tax rights of taxpayers but the important elements of financial assistance, the economic gain to be derived from the interest-free use of the deferred taxes, the accounting problems and many others. Of particular interest to electric utilities is the discussion of the impact upon rate making contained in Chapter 5. Various possible objections to the adoption of rapid depreciation are also raised, considered, and answered in detail. Numerous charts and tables are appended, showing (1) monthly computations of rapid depreciation for new properties; (2) comparisons of annual deductions between new and old methods; and (3) tabulations and formulae showing how to compute the economic gains and the amount of financial assistance.

Practical Approach to Electricity

Fundamentals of Electrical Engineering in M. K. S. Units. **By Edward Hughes. Published by Longmans Green & Co, Ltd., 6-7 Clifford St, London W 1, England. 483 pages, illustrated. Price 12s 6d.**

Written to assist preparation for engineering examinations, this book gains much in understandability by use of the rationalized M. K. S. (meter-kilogram-second) system of units. It covers the complete fundamentals from circuits, electromagnetism, and electrostatics to alternators, motors, lamps, and thermionics. Each subject is developed logically and illustrated by adequate examples. There are many practical cases in the 424 problems and answers from British examinations contained in the book.

This book probably would find limited use in preparation for American examinations. But in its clear presentation and the 424 problems is much information to assist the practical engineer and the specialist who occasionally undertakes problems outside his accustomed field.

Piratininga Steam Station houses two 100,000 kilowatt capability turbine generators, each with its own boiler, these being the largest generator units ever shipped to South America.

ACHIEVEMENT IN BRAZIL . . .

To meet the power needs of the growing Sao Paulo area in Brazil, Stone & Webster Engineering Corporation designed the new Piratininga Steam Station for Sao Paulo Light and Power Company, Limited, an operating subsidiary of the Canadian corporation, Brazilian Traction, Light & Power Company, Limited. Construction for the first unit, now in operation, was completed in a record time of 26 months by Stone & Webster Construction Company.

All available materials were purchased in Brazil, and the field forces, totaling over 1800 at the peak of construction, were recruited locally.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

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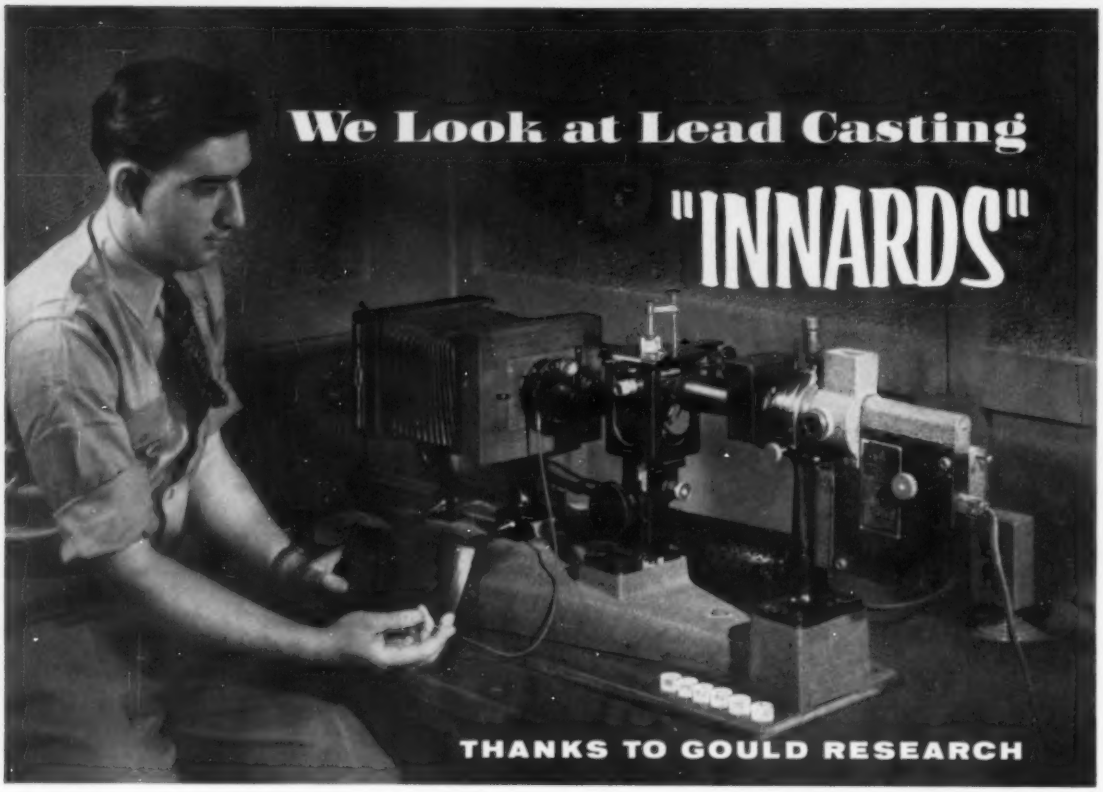


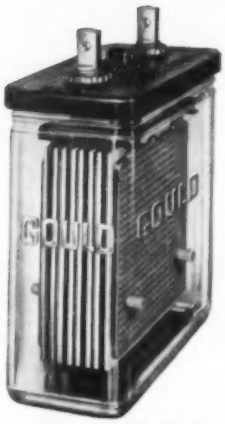
TO GIVE YOU PREDICTABLE
BATTERY PERFORMANCE

Only by looking at its "innards" can the life expectancy of a lead casting be determined. The Metalloscope in Gould's research laboratory enables Gould engineers to do just that.

A combination high-powered microscope and camera, the Metalloscope provides highly magnified photographs of metallic crystalline structures. It played an important part in developing the amazingly strong, long-life Gould Grids.

Continuous research makes every Gould battery a better battery. You'll save money by specifying GOULD.

For the full story on Gould research, send for Booklet 749.



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GOULD
Batteries

GOULD-NATIONAL BATTERIES, INC.
TRENTON 7, N. J.

Always Use Gould-National Automobile and Truck Batteries

Ohio Brass Starts Third Kiln

Regular production of porcelain high-voltage insulators was routed for the first time through the new tunnel kiln at the Ohio Brass Co Barberton plant recently. This 366-ft kiln, the third now in use by O-B, adds 55 million cubic inches per month of porcelain-productive capacity to the Barberton plant. It also allows greater flexibility in production scheduling, and will permit O-B to apply still greater control and efficiency to the firing of high-voltage porcelain insulation.

The new kiln was built next to existing tunnels, and fits into the ware-handling procedures at Ohio Brass Co. Shown is added capacity put to work.

On hand as the first car entered the kiln: foreground, left to right; W. M. Marr, factory manager; J. J. Taylor, chief engineer, and W. H. Burleson, manager of power utilities sales. To the left of the car: J. T. Lusignan, executive engineer, and Louis J. Ott, vice president and general sales manager.

Data Processing Center to Be Built by Sylvania

A Data Processing Center for Sylvania Electric Products Inc is to be erected at Camillus, N. Y., near Syracuse. The site is in excess of 30 acres. Leon C. Guest, Jr., Sylvania controller, said construction of the approximately 50,000 sq ft building may start about May 1, and partial operation is scheduled for Jan., 1956.

The Center will be company-wide in scope and will provide centralization of data processing in one large facility. The company has 9 product divisions and maintains 45 plants and 16 laboratories in 11 states.

"Data processing" will involve the gathering, recording, computing, and classifying of a variety of company-wide information concerning production, volume, sales, billing, and other business data. A Univac electronic computing system has been leased and will serve as the heart of the center.

American Ceramic Society Located in New Home

American Ceramic Society is occupying its new building at 4055 North High St, Columbus, Ohio. The structure, aside from housing the business and publication offices of the society, serves as a show-place of ceramic products and materials.

Exterior and interior construction includes brick, tile, glass block, terra cotta, and fireproof acoustical tile. Unseen materials include sewer tile, flue lines, and chimney and incinerator fire brick.

Annual Report

. . . Atoms and Automation Expand Plants—and Sales

• Allis-Chalmers Mfg Co — Argonne National Laboratory chose the company to design, construct and install the power generation, heat transfer and special equipment expected to be built on the Laboratory's site in Du Page, Ill. This 5,000-kw plant is scheduled for completion in 1956.

• Aluminum Co of America—Transportation and building products continued to be the leaders in aluminum consumption in 1954. These give strong indications of remaining at the top for some time. Plans call for an additional hydroelectric facilities on Little Tennessee River near Alcoa, Tenn.

• American Locomotive Co — Proposed corporate name to be Alco Products, Inc. AEC contract was received for Army atomic package power plant.

• Byron Jackson Co—Pumping equipment is being furnished for AEC's Hanford plant and for North American Aviation's new nuclear power plant.

• General Electric Co—Some projections are made into 1955. An increase is expected over 1954 in sales for commercial products. A reduction is anticipated in defense sales from the high levels of 1953 and 1954. About $165 million is to be spent in 1955 for modernization and expansion of laboratories, plant and equipment.

• Kennecott Copper Corp—A method to increase copper recovery from the refractory ores of the properties in Arizona and New Mexico has been successful in pilot plant testing.

• Lenkhurt Electric Co—Engineering research work has been stepped up in carrier and microwave. In the sales picture there has been an increasing demand for multi-channel microwave systems.

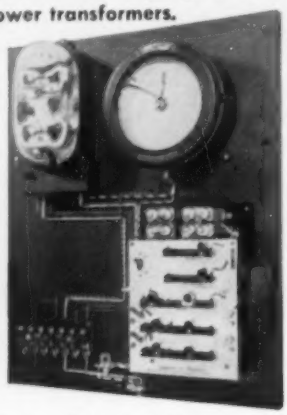
• Minneapolis-Honeywell Regulator Co—Year's record operations reflected a continuing trend toward greater use of automatic control equipment in industry, in heating and air conditioning industries, in aircraft and other markets.

(*Continued on page* 206)

Transformer Loss Compensator

Saves you Money!

BECAUSE it provides an accurate means of measuring the energy and demands of high-voltage services at the low-voltage side of the power transformers.



This installation at 2.3 kv saved about $2600 compared with 34.5 kv metering; it saves about $5500 over metering at 69 kv.

THE TESCO compensator adds to the registration of the watthour meter an amount equal to the sum of the iron and copper losses of the transformer bank. It may be used with practically any type of watthour meter and . . . importantly . . . no changes are made in the meter itself, either structurally or in adjustments . . . It is produced in two and three element types for use with two-element or three-element meters on any type circuit.

Some of the Users . . .

Phila. Electric Co. Penna. Power & Light Co. Texas Power & Light Co. U. S. Bureau of Recl. Public Service Co. of New Hampshire. Utah Power & Light Co. Northern States Power Co.

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Detailed information on operation, installation, applications. Write for Bulletin NO. 63-A.

EASTERN SPECIALTY CO.

PHILADELPHIA 40, PA.

Annual Report

(*Continued from page* 205)

• Minnesota Mining & Mfg Co—Electrical product developments included new thermo-setting tapes, pipe wrap, and wire connectors. Pressure-sensitive and gummed tape products accounted for about 37% of sales, electrical tape and insulation products for about 16%.

• Philco Corp—Color television will not become important commercially until a lower cost system than any now available has been developed and perfected. New automatic equipment was developed and installed for volume production of transistors, diodes and receiving tubes.

• Radio Corp of America—Industrial electronic applications expanded notably with emphasis on closed-circuit television, electronic inspection and production control equipment, and communications systems. An automatic production machine is being built to manufacture a wide range of electronic apparatus. A new system called Electrofax was developed for making copies of printed material.

• Reynolds Metals Co—Preliminary work has been conducted on use of Boral as a shielding material. Boral is essentially a mixture of boron carbide and aluminum. It is rolled in a sheet, clad with aluminum, and used to absorb thermal neutrons.

• Square D Co—The Industrial Controller Division devised new systems and control applicable to automation, with some phases embodying electronics. New manufacturing plants in Secaucus, N. J., and Cedar Rapids, Ia., are expected to be completed in mid-1955.

• Sylvania Electric Products Inc—An Electronic Systems Division was formed. "Stacked Tube" was developed capable of withstanding enormous shock and vibration, and extreme temperature variations. The 1954 operations showed definite trends in the electronics industry, and it may be used in predictions for 1955.

• Westinghouse Electric Corp—A gain in 1955 of about 10% in new orders is anticipated over 1954. This is because of the relatively stable demand for consumer products and for general industrial products, and because it is expected that orders for heavy electrical equipment will continue to increase.

Allis-Chalmers Develops New Silicon Insulation

Allis-Chalmers Mfg Co has developed the reportedly first all-silicone-rubber insulating system for large motors and generators. Known as the Silco-Flex system, it is immediately available for all Class H insulated form wound coils and for Class A and B windings operating under certain service conditions.

Silco-Flex insulation uses Dow-Corning's Silastic silicone rubber as its basic material and makes available the advantages inherent in silicone base insulations.

In the manufacture of Silco-Flex insulated stator coils, silicone rubber is applied to conductors, and vulcanized into a homogeneous mass by the application of controlled heat and pressure. The result is a sealed, impervious dielectric barrier, continuous around the coil and leads, which forms a flexible, moisture and heat-resistant wall over the entire coil structure, according to an explanation.

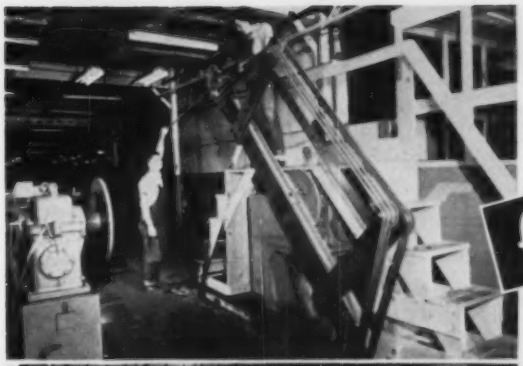
Regarding applications, in power plant induced draft fan motors, for example, the abrasive cinder and fly ash contaminated atmosphere will have little effect on Silco-Flex insulated windings, the company stated. Some applications that formerly required totally enclosed frames may now be handled with semi-protected or open type frames.

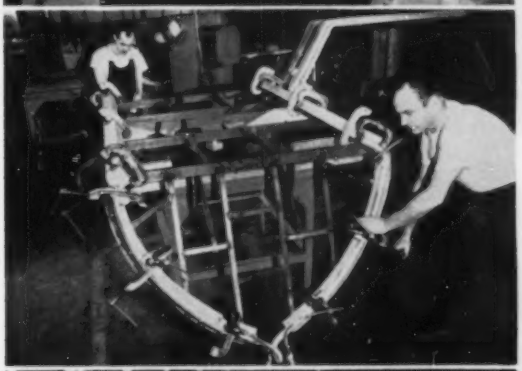
Large machines in the 2,300 and 4,000-v insulation class, wound with Silco-Flex insulation, are being built. Higher voltage windings will be available soon. The insulation will be priced on the same basis as previous Class H insulations. Engineers expect that as new production techniques can be worked out, the advantages of silicone rubber can be applied to an even wider range of motor types and ratings.

Curtis Lighting Expands

Curtis Lighting, Inc, has started operations at its new Alzak aluminum plant. This plant cost an estimated $100,000 and is expected to increase production capacities by more than 100%. While only half of the new plant is operating now, full scale operation will begin in about 60 days.

(*M & M Briefs on page* 208)





The three photos above were taken recently in our plant during production on an emergency schedule of a set of stator coils for a large turbo generator. Despite the large size of the machine, a complete set of 54 coils (each weighing 130 lbs.) was ready to ship 24 working days after the order was received. While coils were being manufactured, a crew had completed restacking the burnt-out laminations on the stator. Coil installation and testing required only 14 working days and the generator was back at work. Complete details on this job available on request.

Why you can count on National for fast rewinding service:

- a large staff of skilled engineering specialists
- wide experience with all types of large rotating electrical equipment, including that of foreign manufacture
- a wire mill and an extensive stock of raw copper for on-the-spot wire production as it is needed
- a complete department for the fabrication of all necessary insulating materials
- specialized tools and equipment for every operation
- a large crew of skilled workmen for coil production and installation
- highly competent field engineers for on-the-job supervision of coil installation — anywhere in the world.
- a willingness to work around the clock, if necessary, until your out-of-service equipment is back at work

Don't wait until an emergency arises to get acquainted with National facilities and services. Write today for the complete story.

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

As utility companies have improved and expanded to meet ever-increasing demand, their need for sound financing has grown too.

To meet these specialized needs, more and more utilities turn to Guaranty Trust Company. By long and close association with utilities, our knowledge of the industry and its problems is also at an all-time peak today.

The officers of our Public Utilities Division will welcome the opportunity to serve you in any phase of utility financing.

Guaranty Trust Company of New York *Capital Funds $395,000,000*

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PARIS: 4 Place de la Concorde BRUSSELS: 27 Avenue des Arts

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MANUFACTURING BRIEFS

Cornell-Dubilier Electric Corp is erecting a new plant on the West Coast to handle engineering, design, and sample production of C-D capacitors and filters. The one-story structure located on the west side of Los Angeles is nearing completion and is expected to be opened late this month. Paul M. Keufler has been appointed general manager.

Lima Electric Motor Co of Lima, Ohio, producer of industrial motors, selective-speed machine tool drives, and speed reducers, is expanding its manufacturing plant and increasing its production facilities, reports H. E. Reeder, president. Construction is scheduled for completion in approximately three months.

Westinghouse Electric Corp will construct a combined manufacturing plant, engineering, and office building for production of military electronic equipment. This major expansion will be near Friendship Airport, Baltimore, Md, and will have 350,000-sq ft floor area. Walter E. Benoit is Electronics Division Manager. Full occupancy and full operation is planned for January 1956. Approximately 150 additional engineers may be employed in this Division.

Sunbeam Lighting Co of Los Angeles, Calif., has broken ground for a 26,000 sq ft addition for production and engineering departments. Expanded parking facilities, photometric laboratory developments, and lighting displays are also planned.

American Steel & Wire Division of United States Steel Corp is opening a 4,800-sq ft warehouse at Paddock Park and Center St in Massena, N. Y., to serve the development of the St. Lawrence Seaway. Stanley S. Williams has been appointed to handle electrical products; Edward C. Carey Jr. will handle wire rope products.

I-T-E Circuit Breaker Co is moving its New York City office on May 2. The new address will be 233 Broadway, New York 7, N. Y. This office will include the Switchgear Division, Small Circuit Breaker Division, R&IE Equipment Division, and Rectifier Division. A. E. MacKenzie is manager.

Any electric utility company

with peak and/or seasonal demands that strain existing facilities, should consider this:

General Motors Electro-Mobile Power may be purchased for single or multiple applications—to fit the KW. needs—requiring no greater an investment than *present* power demands justify.

The capital investment in Electro-Mobile Power is far less than that of a steam installation for low load factor uses.

The fixed charges on Electro-Mobile Power units are materially less than those of any alternate power source.

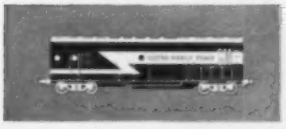
Line loss is reduced to a small fraction by placing this flexible Electro-Mobile equipment at the point of need.

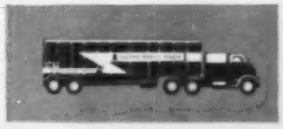
The equipment is designed to be moved from site to site with negligible cost in time or money.

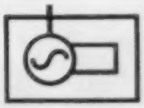
Write for simple formula explaining investment advantages of Electro-Mobile Power:

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS • LA GRANGE, ILLINOIS

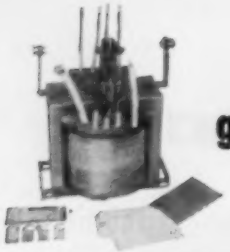






Rail car, truck trailer and portable units—350 to 1,000 KW.

Sold and serviced directly through a manufacturer's organization. Electro-Motive Division offices located in: New York City, Chicago, Jacksonville, St. Louis and San Francisco.



Complete Replacement Kit

When you replace CORE & COILS get original factory quality

ALLIS-CHALMERS CORE and COIL Replacement Assemblies

Allis-Chalmers core and coil assemblies are dried, assembled and tested at the factory using the same skill and advanced equipment as on standard A-C distribution transformers. They can be used in any make tank.

All replacement units are packaged under oil in a specially designed metal drum that protects against moisture and damage during transportation. Complete instructions for installation are enclosed with each unit.

Assemblies are available in ratings 25 kva and smaller and conform strictly to NEMA standards. They can be used either in conventional or protected types. Provisions for mounting low voltage breakers and windings to operate signal light are standard.

Special Moisture-Proof Package

Easy to Install 4 Simple Steps

Get the facts by calling your nearby A-C office or writing Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 61B6345A.

A-4556

ALLIS-CHALMERS

Easy to Install
a new superior system of
CABLE and TUBING race ways
GLOBE'S CABLE WAY
Saves Time
Saves on Material
Galvanized
No Maintenance problem
A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.
Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point—insides and bottom always smooth—all sections punched for easy installation—perfect fit at all times. Neat, clean and uniform in appearance.
Write for new complete catalog.
Distributors in all principal cities.
Contact the Grip-Strut distributor under "Grating" in the classified telephone directory.
THE GLOBE COMPANY
Manufacturers Since 1914
4000 S. Princeton Ave.
Chicago 9, Ill.
Globetray
THE GLOBE COMPANY
CHICAGO 9, ILLINOIS

SALES ASSIGNMENTS

COMPANY STAFFS

Graybar Electric Co has announced the following appointments for its Houston District: J. T. Kinney, former assistant district operating manager in New York, was advanced to operating manager at Houston: J. A. Peterson, with the company for nine years, was named branch manager at Jackson, Miss., replacing A. N. Saxon who becomes manager, Corpus Christi branch.

Elliott Co has promoted F. L. Humphrey, Jr, who joined the company in 1928, from assistant district manager to manager of the Atlanta District.

International Harvester Co's Motor Truck Division has transferred Wayne E. Green as district sales manager from New Orleans to Chicago.

Joseph T. Ryerson & Son, Inc, has named Gordon F. Witt, associated with the General Sales Division for the past three years, as field representative for the tubular products and cold finished bar department at the Milwaukee plant.

Westinghouse Electric Corp's Electric Appliance Division has announced the advancement of M. J. Guiheen, formerly product supervisor on water coolers and dehumidifiers, to district manager of refrigeration specialties in the eastern region.

Worthington Corp has named J. H. Loomis as manager of the corporation's St. Louis office, succeeding P. A. Mack, recently appointed as special representative to develop business through special customers and assignments. Previously, Loomis was general line salesman and compressor specialist at Worthington's Chicago District office.

Lighting Division of Sylvania Electric Products, Inc, has announced the transfer of Robert L. Kuschwa from Buffalo, N. Y., as fixture sales representative to Chicago as supervisor of fixture sales in that area.

Line Material Co has appointed Ralph E. Norman as field engineer, headquartered in Canton, Ohio, and representing L-M in central Ohio and West Virginia. Norman has had several years experience in distribution and power sales engineering.

REPRESENTATIVES

Roller-Smith's Electrical Switchgear Division has designated the J. G. Pettyjohn Co, 234 Daylight Building, Knoxville, Tenn., as sales representative in the Tennessee District.

R. E. Uptegraff Manufacturing Co has announced the appointment of following new sales agencies: Virgil Marshal, 922 No. Audubon Road, Indianapolis, for Indiana with exception of northern counties; Benson, Funk & Associates, 1357 Washington St., Newton, Mass., for Maine, Vermont, New Hampshire, Rhode Island, and eastern half of Massachusetts; W. W. Jackson, Southbury, Conn., for Connecticut and western Massachusetts; Eads Co, Dunlavy St., Houston, for southern Texas and four Louisiana counties; Commercial Engineering Co, 1627 K St., N.W., Washington, D. C., for that city and Maryland; Moreland Engineering & Sales Co, No. Duke Street, York, Pa., for central Pennsylvania and Griffin & Griffin, 931 W. Peachtree St., N.E., Atlanta, for Georgia.

The Univac Scientific Computing System

Operation Thinking Cap...

It takes more than a slide rule alone, these days, to perform the computations necessary for scientific problems such as those encountered in atmospheric research. The scientist of today, equipped with modern data-gathering devices, is faced with a stupendous data-reduction task which requires extremely high speed computation. That's why the Univac Scientific electronic computing system (formerly known as the ERA 1103) has proven to be invaluable to scientists and engineers alike.

Because of its ability to reduce large volumes of data at tremendous speeds, the Univac Scientific System easily handles even the most difficult research problems. Its speed is matched by many other outstanding characteristics including: superb operating efficiency, obtained through large storage capacity... great programming versatility...the ability to operate simultaneously with a wide variety of input-output devices... and far greater reliability than any computer in its class.

For more information about the Univac Scientific System or for information about how you might apply the system to your particular problems, write to ...

ELECTRONIC COMPUTER DEPARTMENT **Remington Rand** ROOM 1446, 315 FOURTH AVE., NEW YORK 10

Baltimore G&E Elects Albrittain VP

Baltimore Gas & Electric Co (formerly Consolidated Gas, Electric Light & Power Co of Baltimore) has announced the election of Mason C. Albrittain, general sales manager of the utility, as a vice president.

Charles P. Crane was elected chairman and renamed president of the company. The officers were elected by the board following a stockholders' meeting at which the name-change was voted.

Albrittain, a graduate of the University of Maryland's school of electrical engineering, started with BG&E in 1924 as a junior sales representative and was advanced through several posts within the industrial power department. In 1947 he was made assistant general manager of the department and two years later was named general manager of industrial and commercial sales and promotions.

When the utility's sales organization was revamped in 1952, Albrittain was appointed general sales manager and placed in charge of company-wide sales and promotional activities. The new vice president will continue his duties in this capacity.

M. C. ALBRITTAIN

Quinton, Bennion Sign Coffin Award Citations

H. QUINTON and H. S. BENNION

Harold Quinton, Edison Electric Institute president, and Col H. S. Bennion, EEI managing director, are shown signing Coffin Award citations. Winning utility will be announced at EEI's June convention, Los Angeles.

Arizona Public Service Co, Cleveland Electric Illuminating Co, Pennsylvania Power & Light Co, and Texas Power & Light Co are the nominees for the annual Charles A. Coffin award. Presented by General Electric Co through EEI, award honors contributions to the industry and to customer service.

Olson Named Commercial VP

Harold A. Olson, manager of the New York sales district of General Electric's Lamp Division, has been made a commercial vice president. In his new post, Olson will be responsible for customer relation activities in the New York territory.

After joining GE in 1916 at the Nela Park headquarters of the Lamp Division in Cleveland, Olson left to serve in the Navy during World War I. When he was discharged as an ensign in 1919, he took time out to attend Syracuse University, where he received a Bachelor of Science degree in electrical engineering.

Rejoining GE in 1925, Olson was assigned to sales and engineering field work. Subsequently, he was appointed to various sales-executive posts in Chicago, Cleveland, Portland, Ore., and New York City.

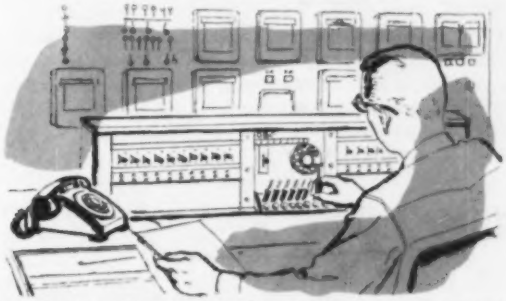
H. A. OLSON

6 ways to save money in communications

If you want to save money and, at the same time, increase efficiency, let the Bell System furnish your communications. To get the facts, Bell System engineers will gladly make a joint review with your people. Ask your Bell telephone representative for more information.

BELL SYSTEM GIVES YOU COMMUNICATIONS AT LOW COST

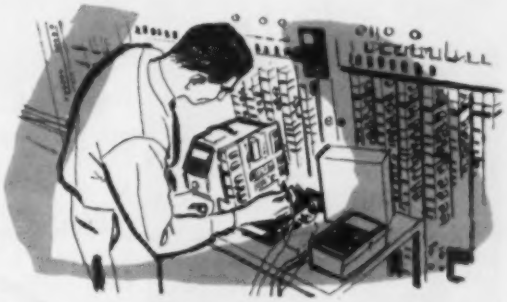
TAILORED COMMUNICATIONS—Bell System engineers fit your communications to your needs. You get precisely what you require. No more, no less.



FLEXIBLE COMMUNICATIONS—Designed to meet your exact requirements, Bell System communications may be expanded or rearranged to match the changing needs of your business.

NEWEST EQUIPMENT—The latest developments in communications equipment are available to keep your service at peak efficiency without investment of your capital.

ROUNDED EXPERIENCE—You benefit from years of Bell System experience with specialists in all phases of communications.



RELIABLE MAINTENANCE—You are relieved of repair and replacement worries. And Bell System preventive maintenance insures that your communications stay reliable.

YOUR MONEY is available to invest in revenue-producing projects, not tied up in communications equipment. A fixed monthly charge covers your exact needs.

BELL TELEPHONE SYSTEM

TELEPHONE MOBILE RADIO TELETYPEWRITER INTERCOMMUNICATION AND PAGING SYSTEMS TELEMETERING AND REMOTE CONTROL

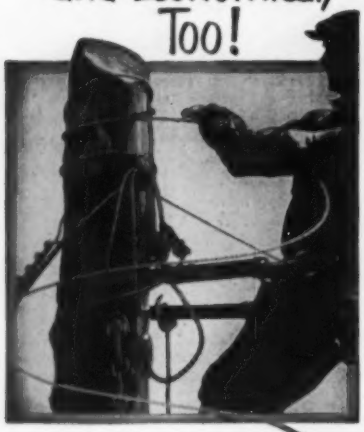
Crapo
GALVANIZED STEEL
STRAND

Strong...
to support pole structures under adverse ice and wind loadings.

Rugged...
to withstand the punishment incurred in construction and service.

Long-Life...
provided by famous Crapo Galvanized heavy, ductile, tightly-bonded zinc coatings.

-and Economical, Too!



● Each size and grade of time-proved Crapo Steel Strand utilizes the superior tensile strength of steel to the fullest advantage. Next time, specify Crapo Steel Strand for guys, messenger and overhead ground wires . . . and save on maintenance!

REINFORCE and PROTECT YOUR CONDUCTORS with Preformed ARMOR RODS

Minimize wear and chafing . . . Absorb and dissipate vibration . . . Protect against arcing and flash-overs . . . Increase holding power against slippage . . . Lessen possibilities of corrosion . . . Reduce overall maintenance costs.

Contact your jobber of Crapo Galvanized Products or write direct for further information!

INDIANA
STEEL & WIRE COMPANY
MUNCIE, INDIANA

Nielsen Elected Executive VP

M. Nielsen, vice president of Babcock & Wilcox Co, has been elected to the newly created post of executive vice president. L. S. Wilcoxson, a vice president, replaces Nielsen as head of the Boiler Division.

With Babcock & Wilcox for 21 years, Nielsen has had considerable experience in the erection, contract, and manufacturing departments. He was promoted to executive assistant in 1950, over the company's contract department. And in 1952 he was made an assistant vice president. The following year, as an elected vice president, he was placed in charge of the Boiler Division's manufacturing department. He was made responsible for the entire division in 1954.

M. NIELSEN

Flavin Made VP

E. D. FLAVIN

Johns-Manville Corp has announced the appointment of Edward D. Flavin as vice president of the company and manager of special industries in the Industrial Products Division. He succeeds L. A. Baldwin who has retired.

Flavin has been with Johns-Manville for 26 years, starting out as sales representative in the Syracuse District. After serving in several managerial posts, he was promoted to assistant manager of special industries in 1953.

Heads Adequate Wiring Study

Harry Restofski, vice president of West Penn Power Co, has been appointed chairman of a new Edison Electric Institute committee to study the problem of inadequate wiring and to investigate what EEI and the electric utilities can do to better promote adequate wiring.

Restofski, who also has served as chairman of EEI's commercial division general committee, was named head of the new group at the recent EEI sales conference.

H. RESTOFSKI

PERSONAL BRIEFS

NCEA, Minn. Co-op

John W. Lapham, secretary-manager of North Central Electric Association in Minneapolis, has announced plans to retire in November. He will be succeeded by **Lloyd F. Wilkes,** assistant secretary-manager . . . Minnesota Electric Cooperative, Minneapolis, has elected **Albin Holmgren** as president, to replace **Harry Edmunds,** and **Lynn Wulkan** and **Melvin Ouse** as vice presidents.

Reynolds Metals

Directors of Reynolds Metals Co have elected three new vice presidents: **Calvin E. Coghill,** who will continue as treasurer of the company; **John Krey,** former assistant to the president; and **W. Monroe Wells,** until recently assistant vice president of operations.

FACTS ABOUT Exide®
CONTROL AND EMERGENCY LIGHTING BATTERIES

LARGEST U.S. UNATTENDED HYDRO PLANT DEPENDS ON EXIDE®-MANCHEX BATTERIES

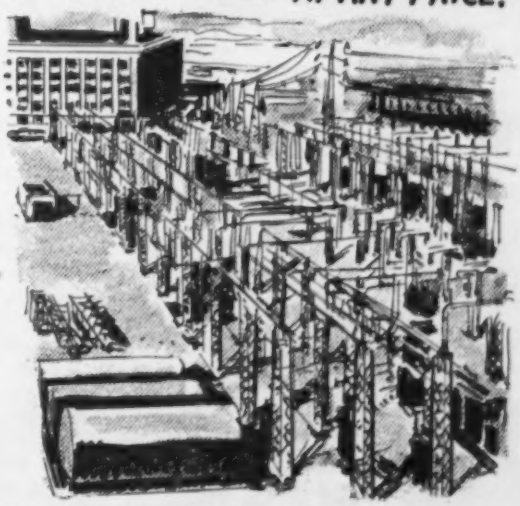
THIS 33,700 KW HYDROELECTRIC PLANT IN WISCONSIN NEEDS NO OPERATORS — IT IS RUN BY REMOTE CONTROL. EXIDE-MANCHEX BATTERIES ARE USED TO FURNISH DEPENDABLE STANDBY POWER FOR SWITCHES, CONTROL CIRCUITS AND EMERGENCY LIGHTING. EXIDE-MANCHEXS DO ALL THIS AT LOW COST FOR OPERATION, MAINTENANCE AND DEPRECIATION. THEY ARE YOUR BEST BATTERY BUY FOR ALL CONTROL AND SUBSTATION SERVICE!

INSIDE AN EXIDE-MANCHEX
THE SECRET OF LONG LIFE...
DEPENDABLE POWER!

THE EXCLUSIVE MANCHESTER POSITIVE PLATES ARE THE HEART OF THE MANCHEX BATTERY...THE SOURCE OF POWER. LEAD BUTTONS ARE PRESSED INTO HOLES OF THE GRID. ONLY A SMALL PORTION OF THE TOTAL LEAD IS FORMED INITIALLY INTO ACTIVE MATERIAL. THE REMAINDER IS AVAILABLE FOR GRADUAL CONVERSION DURING YEARS OF SERVICE. YOU GET LONGER LIFE... MORE DEPENDABLE POWER IN LESS SPACE!

26 YEARS OF EXIDE SERVICE!

A GOOD EXAMPLE OF THE LONG LIFE OF THE EXIDE CONTROL BATTERIES COMES FROM THE LARGE WESTMORELAND SUBSTATION OF THE PHILADELPHIA ELECTRIC COMPANY. ONE 120-CELL EXIDE WAS INSTALLED IN DECEMBER 1927, ANOTHER IN FEBRUARY 1928. TWENTY-SIX YEARS LATER THE FIRST WAS REPLACED WITH A NEW, IMPROVED EXIDE-MANCHEX- THE OTHER BATTERY CONTINUES TO PROVIDE DEPENDABLE SERVICE! LONG DEPENDABLE SERVICE IS WHY EXIDES ARE YOUR BEST POWER BUY—*AT ANY PRICE!*



LET EXIDE HELP SOLVE YOUR SWITCHGEAR BATTERY PROBLEMS. ❶ CALL AN EXIDE SALES ENGINEER FOR FULL DETAILS. ❷ WRITE FOR BULLETIN 210-WHICH TELLS HOW BATTERIES ARE MOST EFFICIENTLY USED IN SWITCHGEAR OPERATIONS.

Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.

DESIGNED for quick, low cost trench digging for foundations and all types of service lines.

LADDER type permits efficient operation in the closest quarters and under difficult conditions.

CUTS up to 5 ft. in depth in 8" to 12" widths; 4 ft. in 14" and 16" widths; straight and clean.

THE NEW BUCKEYE 403

For Fast, Low Cost Utility Ditching

The 403 is a small, easy-to-maneuver machine for digging water, gas, sewer, building foundations . . . Low bearing electric or telephone lines and for pressure to avoid damage to lawns or walkways . . . Easily transported from job to job and will travel over almost any type ground. Digs a clean, straight-sided trench with squared corners. Complete details from your distributor.

No. 5512

GAR WOOD INDUSTRIES, INC.
WAYNE, MICHIGAN

Personal Briefs

(*Continued from page* 214)

Permutit Co has announced that **Sheller L. Steinwender** has joined the company as a vice president.

Thomas P. Swift, former New York Times financial and business writer in utilities, has joined Bozell & Jacobs, Inc, advertising and public relations firm. He will work on public information program for the industry.

W. W. Lynch, president of Texas Power & Light Co in Dallas, and **John P. Madgett,** general manager of Dairyland Power Co-operative, La Crosse, Wis., have accepted appointments to the Inter-Industry Farm Electric Utilization Council.

Pacific Gas & Electric Co has named **W. Frank Pape,** North Bay Division manager for the utility, as head of the East Bay Division, succeeding the late William H. Park. **Elias S. Day** fills Pape's previous post.

OBITUARY

Curtis E. Calder, 64, executive committee chairman of Electric Bond & Share Co, died April 2 in Presbyterian Hospital, New York. Calder had served as president of Texas Power & Light Co, Dallas Power & Light Co, and Texas Electric Service Co.

Buford H. Reeves, 63, president of Rockbestos Products Corporation in New Haven since March 5, died in his office April 1. He had been associated with the company for 22 years.

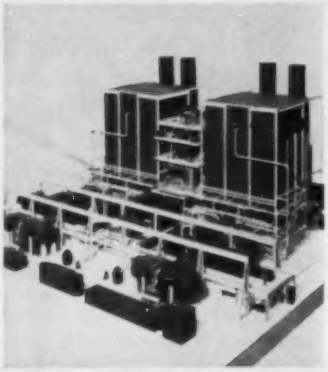
W. B. Carnie, 56, superintendent of transmission at Montaup Electric Co in Somerset, Mass., died March 28.

Daniel J. Finucane, 61, manager of the New York sales district of Revere Copper & Brass, Inc, died April 3 in Long Island, N. Y.

Raymond A. Schmidt, 49, manager of the Western Division of Dayton Power & Light Co, died March 27 at his home in Greenville, Ohio.

William H. Park, 53, manager of Pacific Gas & Electric Co's East Bay Division, died in Oakland, Calif.

Industrial Models Inc.



ADD 3-D TO YOUR DESIGN PICTURE

Industrial models help you see through construction and design problems before the blueprint stage. Save up to 30 times model cost by more efficient

- Equipment Arrangement
- Power Plant Layout
- Piping Arrangement
- Field Construction
- Personnel Training
- Maintenance Planning

Save time and effort, cut costs by putting Industrial Models' experienced engineers and craftsmen in your design picture. Write for detailed brochure.

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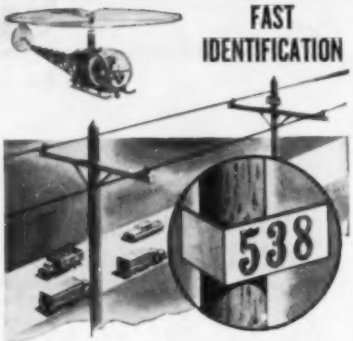
• CLEVELAND • NEW YORK • THE HAGUE



FAST IDENTIFICATION

POLE NUMBERS FOR AERIAL PATROL BY

"They Outlast the Pole"

PREMAX

Premax enameled and plain aluminum pole markers make aerial trouble spotting fast, easy and economical. Made to withstand any weather, designed for extremely high visibility. For R.E.A., telephone and general utility installations. Ask your jobber, or write

PREMAX PRODUCTS
Div. Chisholm-Ryder Co. Inc.
5308 Highland Ave., Niagara Falls, N. Y.

Bethanized Strand has the coating weight you need for any given job

Bethlehem strand with the bethanized coating has an advantage you cannot afford to overlook. It is available not with one, not with two, but with three separate coatings known as A, B, and C. There is no difference in the quality; all are highly-pure zinc, applied by Bethlehem's electrolytic process. But there *is* a difference in the coating *weights*, and that's important.

Coating A, the lightest, is equal to extra-galvanized. Coating B is double the thickness of A; C is three times the thickness of A. All these coatings meet the requirements of the standard ASTM specifications.

Thus, with three weights from which to choose, it is always possible to get the coating you need for any given job. Where line structures and fittings may outlive strand with an A coating, the B coating is more practical. All factors being equal, B will last far longer than A, yet its extra cost is very small.

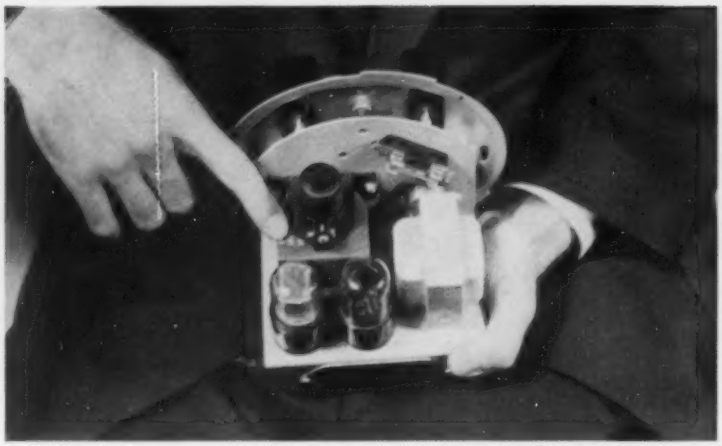
The third coating (C) is recommended for extreme conditions where even the B might not be adequate. Low in cost from every standpoint, C should be chosen when extra-long life is essential, or when corrosive atmosphere demands a heavyweight coating.

For further details, call the nearest Bethlehem office. Our engineers will be glad to give you the full story.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL



Guaranteed 5 KV RMS Rating!

Finest lighting control improvement in 18 years! Exclusive "Mercury to Mercury" main circuit contactor energized by improved layer-wound coil offers maximum resistance to lightning and switching surges. Write today.

American Electric
LIGHTING CONTROLS

Ask for data and price sheets, 3000 series. No obligation.

AMERICAN ELECTRIC MFG. CORP., Dept. D., 34 N. Orleans, Memphis, Tenn.

Another Job Done Better With The ALL-NEW 'Jeep'®

REACHING REMOTE WORK SITES

Beyond the road's end, where the going is rough and steep, you can depend on the sure-footed 4-wheel-drive pulling power of the Universal 'Jeep' to take you right to the job. With a 'Jeep' you can climb steep grades, maneuver your way in dense woods, traverse loose rock and sand—*and get there!* That is why the 'Jeep' has become essential equipment for engineers, surveyors, geologists, miners and lumbermen. Get a demonstration.

WILLYS MOTORS, INC.
TOLEDO 1, OHIO

The 'Jeep' Family of 4-Wheel-Drive Vehicles... UNIVERSAL 'JEEP' • TRUCK • STATION WAGON • PANEL DELIVERY

THE WORLD'S MOST USEFUL VEHICLES

MEETINGS CALENDAR

APRIL

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Spring Meeting, Lord Baltimore and Southern Hotels, Baltimore, Md., April 18-22; Region VIII Meeting, Rice Hotel, Houston, Tex., April 25-26.

***ELECTRIC COMPANIES ADVERTISING PROGRAM**—Management Group, Hotel Pierre, New York, April 20.

NORTHWEST PUBLIC POWER ASSOCIATION—Annual Meeting, Eugene Hotel, Eugene, Ore., April 20-22.

EDISON ELECTRIC INSTITUTE—Industrial Relations Committee, EEI Headquarters, New York, April 21; Hydraulic Power Committee, Atlanta-Biltmore Hotel, Atlanta, Ga., April 25-26; EEI-AGA 1955 National Conference of Electric and Gas Utility Accountants, Conrad Hilton Hotel, Chicago, April 25-27; Meter and Service Committee, Washington-Duke Hotel, Durham, N. C., April 25-27.

PENNSYLVANIA ELECTRIC ASSOCIATION—Spring Meeting, Communications Committee, Hotel Alexander, Hagerstown, Md., April 21-22; Spring Meeting, Meter Committee, Washington-Duke Hotel, Durham, N. C., April 28-29.

ROCKY MOUNTAIN ELECTRICAL LEAGUE—Annual Spring Conference, Shirley-Savoy Hotel, Denver, Colo., April 24-26.

ILLUMINATING ENGINEERING SOCIETY—Pacific Northwest Regional Conference, Harrison Springs Hotel, Harrison Hot Springs, B. C., April 24-27.

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS—8th Annual Conference for Protective Relay Engineers, Sponsored by Department of Electrical Engineering, College Station, Tex., April 25-27.

***NORTH CENTRAL ELECTRIC ASSOCIATION**—Engineering Committee, Dyckman Hotel, Minneapolis, April 25-28.

***NATIONAL INDUSTRIAL CONFERENCE BOARD**—Atomic Energy Course for Management, New York, April 25-30.

CONTROLLERS INSTITUTE OF AMERICA—Eastern Conference, Royal York Hotel, Toronto, Ont., April 28-30.

MAY

ILLUMINATING ENGINEERING SOCIETY—Midwestern Regional Conference, Edgewater Beach Hotel, Chicago, May 2-3; Canadian Region, Mount Royal Hotel, Montreal, May 12-13; East Central Region, Abraham Lincoln Hotel, Reading, Pa., May 19-20.

***RURAL ELECTRIFICATION ADMINISTRATION**—6th Annual Operations & Maintenance Conference, Shirley-Savoy Hotel, Denver, May 2-5.

***EDISON ELECTRIC INSTITUTE**—Transmission and Distribution Committee, Statler Hotel, Detroit, May 3-4; Spring Meeting, Purchasing and Stores, Dinkler Tutwiler Hotel, Birmingham, Ala., May 8-11; Prime Movers Committee, Biltmore Hotel, Los Angeles, May 9-10; Accident Prevention Committee, Pfister Hotel, Milwaukee, Wis., May 9-10; Commercial Electric Cooking Conference, Sheraton Hotel, Chicago, May 10; Electrical Equipment Committee, Rice Hotel, Houston, Tex., May 16-17; Industrial Relations Committee jointly with Personnel Administration Section, Southeastern Electric Exchange, Netherlands Plaza Hotel, Cincinnati, May 19-20.

AMERICAN PUBLIC POWER ASSOCIATION—Annual Meeting, Jacksonville, Fla., May 3-5.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Middle Eastern District No. 2, Columbus, May 4-6; Electric Heating Conference, La Salle Hotel, Chicago, May 10-11; Telemetering Conference, Hotel Morrison, Chicago, May 18-20; Domestic Appliance Conference, Cleveland, May 23-25; Electronic Components Conference, Los Angeles, May 26-27.

***NATIONAL ASSOCIATION OF ELECTRIC COMPANIES**—Annual Meeting, Mayflower Hotel, Washington, D. C., May 5.

***WISCONSIN UTILITIES ASSOCIATION**—Home Service Conference, Edgewater Hotel, Madison, May 5-6.

***PENNSYLVANIA ELECTRIC ASSOCIATION**—Spring Meeting, Transmission and Distribution Committee, Irem Temple County Club, Dallas, Pa., May 5-6; Spring Meeting, Hydraulic Power Committee, Hotel Sheraton-Brock, Niagara Falls, Ont., May 5-7; Spring Meeting, Systems Operation Committee, Skytop Lodge, Skytop, Pa., May 12-13; Spring Meeting, Electrical Equipment Committee, Hotel Roosevelt, Pittsburgh, May 19-20; 1955 Annual Industrial Sales Conference, Bedford Springs Hotel, Bedford, Pa., May 19-20; Spring Meeting, Relay Committee, Abraham Lincoln Hotel, Reading, Pa., May 26-27.

***PUBLIC UTILITIES ADVERTISING ASSOCIATION**—34th Convention, Sheraton Hotel, Chicago, May 11-13.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS—Annual Convention, Commodore Hotel, New York, May 12-14.

***INTERSTATE POWER CLUB**—General Electric Wire and Cable Plant, Bridgeport, Conn., May 20.

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Computer Slide Rule Teamed

(*Continued from page* 122)

economic distribution of system generation were evaluated. The accompanying curve shows the hourly savings in dollars resulting from the inclusion of the effects of incremental transmission losses over the method of scheduling generation by a consideration of incremental fuel costs only. This saving amounted to approximately $150,000 annually when the system had eight major steam plants and a 2,386,000 kw peak. Today it is estimated that annual savings exceed $200,000.

The transmission loss penalty factor computer is a direct result of this development work and research. It was designed and built after the evaluation of several alternative methods available at the time. Study indicated that the combination of penalty factor computer and incremental fuel cost slide rule offered the best solution to the overall requirements of the AG&E System.

Since this decision, significant advances have been made in computing and control equipment for automatic economic allocation of generation. Some of these schemes contemplate including transmission losses by a penalty factor method. The engineering staff of AG&E Service Corp is following these developments closely in the expectation that some fully automatic system eventually will be installed.

The penalty factor computer even then will have highly useful application in forecasting generation and capacity schedules and in determining losses associated with interconnection sales. In these functions, it will continue to afford savings in excess of its original cost.

Automatic Dispatch Pays

(*Continued from page* 124)

the desired quantities are evidently not going to be used. A very close estimate of the proper cost can be made after a few weeks' experience.

To calculate more closely the hydro station kwhr to be utilized, it is not difficult to go through a predicted load cycle with the computer with a particular availability of units and estimate of purchase power. This may be done in advance when new or untried conditions make it inadvisable simply to estimate the cost.

Non-conforming loads are treated on the computer exactly like tie lines. Non-conforming load flows bear no particular relationship to fluctuations of total load. At tie lines or points having non-conforming loads of appreciable magnitude, power is simply set into the computer at the point so that these flows are properly taken into account in determining the economic dispatch of the rest of the system.

Once all data has been set in, it is necessary only to set in the total required generation on the total-generation dial. Then the computer immediately positions itself to show the correct economic dispatch of the power for the variable units of the system. The operator will keep the system dispatched reasonably close to this economic optimum.

Slight deviations will not appreciably increase the generating cost, so that changes can be made in the dispatch at times considered to be the best compromise between system economy and operating cost. When regulating stations are found to be operating steadily above the middle of the band, more power is dispatched to stations operating below the economic indication.

As its development progressed, it became evident that the computer afforded several benefits in addition to the determination of the most economic dispatch of power. Studies indicated that better line loading will result when dispatching allows for transmission losses and the losses themselves will be reduced. Better use of hydro is expected when it is operated at an incremental cost. It can then supply available kwhr to the system at the greatest fuel cost savings.

The problem of determining cost of power at an interconnection for economy interchange has been solved. Both the cost of sale power and the value of energy available from the adjoining company have been determined. Data for after-the-fact billing can also be provided by the computer. The dispatcher has always been perplexed when faced with deciding which units to run and which to shut down. With the computer, alternatives can be tested until the most economical combination appears.

Lastly, the computer will be so designed that it can be used later to route signals to the power stations to raise or lower generation, thus automatically keeping the system in economic balance.

Hawaiian Plant Dedicated

Hawaiian Electric Co has dedicated its new $10 million, 50,000-kw power plant at Honolulu. Territorial Gov Samuel W. King was principal speaker at ceremonies.

APDA Chartered by N. Y.; Cisler Named President

Thirty-three companies—25 investor-owned electrical systems and eight manufacturing, engineering, and research firms—have banded together to form Atomic Power Development Associates, Inc, a nonprofit organization to further peacetime utilization of the atom.

First organization meeting of the group, which started with two companies five years ago, was held last month in New York City. Walker L. Cisler, president of Detroit Edison Co, was elected president, and Alton P. Donnell, project manager for the past year, was appointed general manager.

Birth of the new corporation, chartered under New York State laws, was announced by L. M. Smith, president of Alabama Power Co, which has been engaged in atomic power research with Southern Services, Inc., under an Atomic Energy Commission contract. Permanent APDA offices will be maintained in New York City and Detroit. Utilization of nuclear heat to operate thermal-electric generating plants has been the main concern of the APDA companies, Smith said.

Box Canyon Power Due

Last concrete has been poured for the $17-million Box Canyon Dam on the Pend Oreille River in northeastern Washington. The 260-ft long dam and 66,667-kw powerhouse—project of Pend Oreille County PUD No. 1—will be ready to produce sometime this month.

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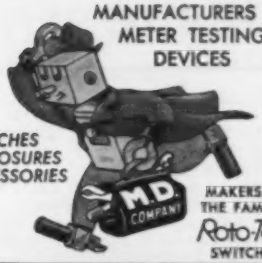

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Bruces Eddy Dam

PNP urges federal government to join group in constructing Idaho project

Four Pacific Northwest power companies are urging the federal government to join them in building the $117.5 million Bruces Eddy Dam on the North Fork of the Clearwater River in Idaho.

Kinsey M. Robinson, president of the four-company Pacific Northwest Power Co, said the combine wants the federal government to build the dam and pay for any nonpower benefits from the dam. Pacific Northwest Power would build a 240,000 kw power-house and pay for falling water.

Robinson indicated that nothing conclusive has come from preliminary talks on the joint federal-private construction proposal. If the government rejects the joint proposal, Robinson predicted that PNP would undertake the entire project on its own, "because we can build it cheaper."

Sees Steam Carrying NW . . . In an interview accompanying the Washington Water Power Co's annual report covering 1954, Robinson, also president of WWP, forecast that within 15 years, steam plants would supply the basic power load for the entire Northwest area, and hydro plants will supplement them. He forecast that most of the steam plants would be erected in coastal areas, rather than inland, because of lower fuel costs. (Fuel would include oil, natural gas and possibly a large deposit of soft coal in Washington's Roslyn area.)

"By the fall of 1960, the Washington Water Power Co will be self-sufficient in its power supply, and for 15 years we will have our own hydro power supply," Robinson said. "After that, the Northwest will undoubtedly go to steam for base loads, and depend on hydro for peak loads." Robinson indicated that WWP probably would purchase steam-generated power when the time comes, rather than undertake steam-generation itself.

As for nuclear power, Robinson said his firm and others have organized teams studying nuclear power at the Hanford plant in south-central Washington.

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Operational changes render surplus. Complete data upon request. Would consider sale of either item separately.

CITIES SERVICE PIPE LINE
Patridge, Bartlesville, Oklahoma

OFFICIAL PROPOSALS

Bids: May 3, 1955

Power Authority of the State of New York

ST. LAWRENCE POWER PROJECT
ADVERTISEMENT FOR PROPOSALS
FOR
THE FURNISHING AND DELIVERY OF GENERATOR AIR CIRCUIT BREAKERS
SPECIFICATION NO. PA-4-14005
ST. LAWRENCE CONTRACT NO. P12

NOTICE TO CONTRACTORS: The POWER AUTHORITY OF THE STATE OF NEW YORK will receive sealed proposals for the design, manufacture, and furnishing of sixteen (16) generator air circuit breakers and appurtenances, and the delivery thereof f.o.b. destination, until 10:30 A.M. Eastern Standard Time on the 3rd day of May, 1955 at the Authority's office, 270 Broadway, hearing room "C" on the sixth floor, New York 7, New York, at which time and place proposals will be publicly opened and read aloud.

Bids will be entertained for the generator air circuit breakers, appurtenances and services in accordance with the bidding schedule. Erection at the site of installation will be done by Others but services of an erecting engineer shall be provided by the manufacturer if and when required. Delivery will be required in groups of 4 air circuit breakers every six months starting September 1, 1957.

Plans, specifications and Proposal Forms for the work will be on file in the Authority's Office and in the offices of the Engineer, Uhl, Hall & Rich, 230 Congress Street, Boston 10, Massachusetts, and the Hydro-Electric Power Commission of Ontario, 620 University Avenue, Toronto 2, Ontario, and may be inspected by prospective bidders during office hours.

Plans, specifications and Proposal Forms may be obtained from the Power Authority of the State of New York, 270 Broadway, Room 1300, New York 7, New York upon application and prepayment of a fee of Ten ($10.00) dollars per initial set of contract documents and Five ($5.00) dollars per set for additional sets, no part of which will be refunded. Two sets must be returned with each bid.

Bids must be made in duplicate upon the proposal forms included in and bound with the Contract Documents. A bid deposit will be required with each bid in an amount not less than 10 percent of the gross sum bid.

The right is reserved to reject any or all bids.

W. S. CHAPIN
GENERAL MANAGER

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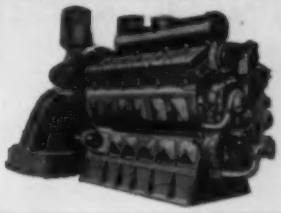
—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU.

DIESEL POWER

IMMEDIATE SHIPMENT
• PURCHASE OR RENTAL
UNIT CAPACITIES—10 TO 2475 KVA
A.C.—50 AND 60 CYCLES
• ALSO D.C. UNITS



A PARTIAL LISTING OF OUR INVENTORY

KW	MAKE	Model	HP	RPM	KW	Make	Model	HP	RPM
1180	Worthington	SEH-8	1685	360	320	Superior	60E-6	460	450
1136	Fairbanks Morse	38D	1600	720	300	Fairbanks Morse	32E14	450	300
1100	General Motors	16-278A	1600	720	300	General Motors	8-268A	450	1200
1000	General Motors	16-567B	1440	720	250	Clark	GD-4	375	360
750	General Motors	12-567	1080	720	200	General Motors	6-268A	350	900
700	Worthington	EE-8	1000	327	175	General Motors	12-71	275	1800
675	Fairbanks Morse	38D	960	720	150	Buckeye	80	240	600
500	General Motors	S-567	720	720	148	Fairbanks Morse	32E14	230	300
500	Alco	6-12 1x13T	720	600	100	General Motors	3-268A	150	1200
350	Baldwin	VO-6	510	450	60	General Motors	6-71	90	1200
320	Enterprise	DSG-6	460	450					

A. G. SCHOONMAKER COMPANY, INC.
DIESEL DIVISION, 50-52 CHURCH ST., NEW YORK 7, N. Y.

MOTOR GENERATOR SETS

KW	Make	A.C.	D.C
1000	G.E.	13200	600
500	Wagn.	4000	250
400	G.E.	2300	275
400	AL.-Ch.	2300	120/240
250	Wagn.	2300	125/250
200	G.E.	2300	230/375
200	Wagn.	4160/2300	375
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	AL.-Ch.	2300	275
150	Wagn.	2300	125/250
150	G.E.	440	275
100	G.E.	2300	250
100	Wagn.	440	125
100	Elec. Mch.	440	125
100	G.E.	440	125
90	G.E	440	60

CHICAGO ELECTRIC CO.
1324 W. Cermak Rd. Chicago 8, Ill.

FOR SALE

One W.H. Transformer, 100 KVA 33000/2400 oil-cooled, 1 phase, 60 cycles, subtractive polarity, Imp. 6.0 Ser. #463694. Two Moloney Transformers, 100 KVA, 16500/33000, oil cooled, 1 phase, 60 cycles, 2300 Volts to 2530, 5.25 Imp. subtractive polarity. Type FC. Serial No. 605530 & 531. Price can be arranged to suit purchaser.

FS-5965, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

TRANSFORMERS
FOR SALE

3—1000 Kva W-H 20000/34650Y-13200
3—1000 Kva Mol. 13200-2400/4160Y
6—1000 Kva Mol. 11500-2400/4160Y
3— 833 Kva G-E 35000—480
3— 500 Kva G-E 25400—240/480
5— 333 Kva W-H 38000-7200/12470Y
3— 333 Kva G-E 33000-2300/4000Y/6900/-11950Y
3— 333 Kva G-E 33000-2300/4000Y
3— 333 Kva Mol. 7200/12470Y-2400/4160Y
3— 100 Kva G-E 33000-6900/11950Y

Many other items in stock.

TRANSFORMERS WANTED
Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
5316 Hetzel St.
Cincinnati 27, Ohio
40 Years' Dependable Service

ELECTRICAL WIRE AND CABLE

—Your Best Source—
• for every industrial and power application
• Odd lengths—long and short—reasonably priced

One of the Largest Stocks in Midwest
Let us quote on requirements—
send your inquiries
We'll also buy Surplus
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2662 N. Clybourn Ave., Chicago 14, Ill.
EAstgate 7-4777 Code: UNIWIRE

Specialist for 47 Years in—

LARGE POWER EQUIPMENT

Do you receive our stock list? Prompt shipment from inventory. A.C. & D.C. Motors, Transformers, M-G Sets, Frequency Changers, Controls, Turbo-Generators and Circuit Breakers. Attractive prices for rebuilt-guaranteed equipment. Contact us before purchasing.

BELYEA COMPANY, INC.
51 Howell St. Jersey City 6, N. J.

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

PUBLIC RELATIONS & ADVERTISING

CP&L Provides Service With Message

How to get 'em while they're young is being demonstrated here by Carolina Power & Light Co. The utility has erected these small weather-proof shelters at 15 school bus stops along highways. They are proving popular with both school children and their parents.

The shelters do double-duty, carrying an advertising message on each side, while providing a much-appreciated extra service among rural customers. Several other Raleigh area advertisers now are sponsoring similar shelters.

Ohio Power Plants Trees For Future Generations

Ohio Power Co has begun its annual tree planting program on about 1,100 acres of mined banks and unmined land on its strip mine areas in southeastern Ohio.

This is the 12th year of the company's reforestation and reclamation program. The 1,065,000 tree seedlings to be planted this year will bring to 6,185,000 the number of plantings which have been made on more than 10,750 acres of mined banks and unmined land. A 70-man crew is working on the project this year.

A wide variety of trees is included in the program. There are different types of pines, mixed hardwoods, and 25,000 seedlings to be harvested as Christmas trees. Some of the benefits of this program will not be realized until 100 years from now.

Rice Scholarships Grant

Houston Lighting & Power Co has established five liberal arts scholarships to be awarded freshmen at Rice Institute. Each calls for a $300 stipend which may be used for living and other incidentals at the institute.

These are reported to be the first liberal arts scholarships to be established at Rice by a business enterprise. Applications and awards are handled by the Institute.

Georgia House Praises Utility For Aiding State

Georgia Power Co has won the commendation of the state House of Representatives for its Better Home Town program.

The Georgia house recently passed a resolution thanking the power company for its action and urging other businesses in the state to do the same thing.

The resolution stated among other things that the plan has:

"Dynamically increased and grown to such an extent the appearance of many small communities has been revolutionized, and while heretofore these same places had only a dormant interest in improving the looks of, and building the needed civic facilities and projects in these towns, yet this plan has so awakened and stimulated those interests that the face and usefulness of these towns has greatly changed to a degree that has transformed the whole spirit, quality, and productivity of these communities."

FP&L Uses Open Mailing For 1954 Annual Report

Florida Power & Light Co this year has adopted a unique method of mailing its 1954 annual report—unique for an annual report. The company is sending the pamphlet through the mails open just as a good many magazines are mailed.

Vice President Malcolm B. McDonald says: "Aside from saving postage and the cost of inserting in an envelope, we feel that its attractive cover and open mailing invites greater readership, resulting in better stockholder interest and understanding."

The report carries the title "Florida, Land of Sunshine."

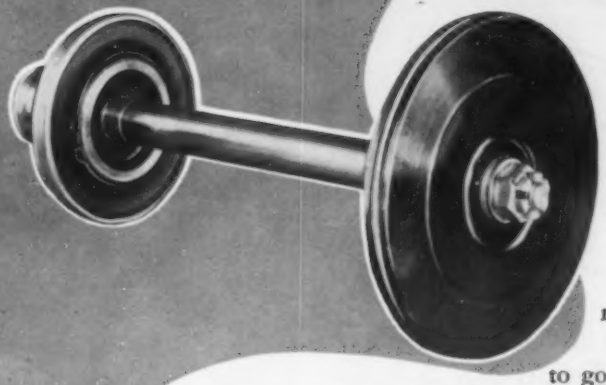
Scanning the Ads

Alabama Power Co: "Weather Forecast: Hot and Humid. Will You Be Cool and Comfortable?", what to do about wiring before installing air conditioner . . . **Connecticut Light & Power Co:** "Timber-r-r!", a plea for planned tree planting to avoid line damage in stormy weather . . . **Georgia Power Co:** "There's a Better Way to Lend Luster to a Name" (than polishing a name plate), make company name stand for something.

Kansas City Power & Light Co: "Only Electric Cooking is White Glove Clean" . . . **Kansas Gas & Electric Co:** "Electricity Works While You're Away," ad tells how electricity saves time and effort . . . **Metropolitan Edison Co:** "This Family is Always in Hot Water," because it has an electric water heater . . . **Northern States Power Co:** "Homemade Electric Granary System Saves Wages of Two Men," one of series of ads pushing electricity on the farm.

Pennsylvania Electric Co: "Only This (electric range) Gives You 'No-Waste' Heat" . . . **Philadelphia Electric Co:** "You Can Read by Candlelight . . . or by the Old Oil Lamp . . . But a Thousand Times Better by Electricity!" . . . **Public Service Electric & Gas of New Jersey:** "Do The Eyes Have It?," urges better lighting and invites requests for free booklet "Lighting Recipes."

THIS IS THE BLAST VALVE...



THIS blast valve plays a critical role in the operation of a Brown Boveri Air Blast Breaker. It controls the flow of *air* which extinguishes the arc between the contacts. Its small size, its light weight, its freedom from mechanical linkages to avoid undesirable friction, conform to good circuit breaker design.

A Brown Boveri Air Blast Breaker is today's most advanced engineering accomplishment in breaker design. It solves the design problem of getting the interrupting medium between the contacts as quickly and as efficiently as possible. Its use of AIR (a low-inertia medium in contrast to OIL), controlled by a few, light, moving parts like this blast valve account for its inherent high speed and outstanding reliability!

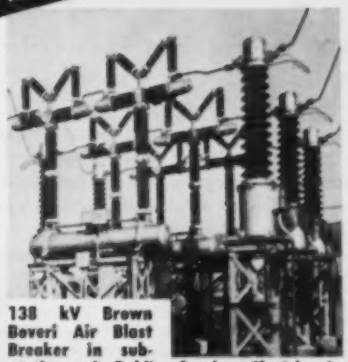
BROWN BOVERI

AIR BLAST BREAKERS

up to 330 kV

Only a Brown Boveri Air Blast Breaker can possibly provide ALL these advantages:

- High Interrupting Capacity
- High Current Carrying Capacity
- High Speed
- Rapid Reclosing
- Positive Interruption under All Conditions
- Proven Dependability
- No Fire Hazards
- Low Initial Cost
- Low Installation Cost
- Minimum Maintenance
- Rapid and Easy Inspection



138 kV Brown Boveri Air Blast Breaker in substation of Public Service Electric & Gas Company of New Jersey.

BROWN BOVERI

You can EXPECT MORE...and GET MORE... from a Brown Boveri Air Blast Breaker. Get the FACTS, today!

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READERS FORUM

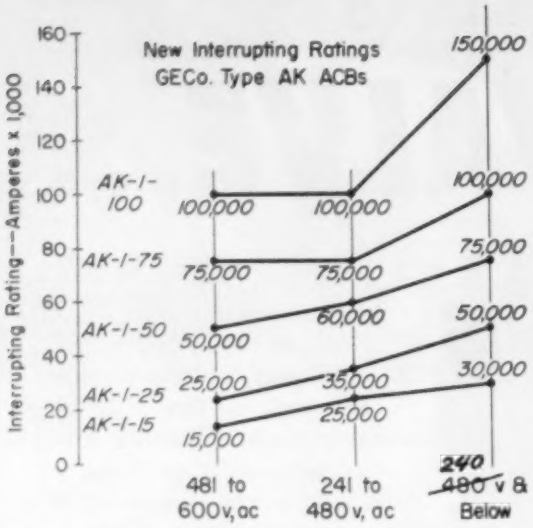


CHART as it should have appeared

An Instance Where EW Erred

To the Editor:

Technical data in Electrical World are always tops. But sometimes, not often, they are incorrect. One of these instances can be found on page 59 of the Feb. 28 issue. In the chart concerning the increase in interrupting ratings of the General Electric AK line of air circuit breaker, the last column is incorrectly labeled as "480 v and Below." The correct label is "240 v and Below."

W. E. Hunt
Switchgear Division

General Electric Co
Philadelphia, Pa.

EW Prod Brings Out Official Figures

To the Editor:

As a result of the little prod we got from your tabulation in Electrical World, Feb. 7, page 61, on the cost of relocating electric facilities, in connection with federal aid to roads program, we in Michigan have come up with what we think is a more realistic figure than we have had before.

For your information, the total cost of all utilities in the state is approximately $1,700,000, exclusive of betterment, and the electric utilities' cost is about $520,000. These are the figures that were turned into Washington.

Thanks again for the prod in getting Michigan to get some realistic figures compiled.

G. H. Tuttle
Director, Public Information Department

Detroit Edison Co
Detroit, Mich.

● More about federal aid to roads program appeared in EW, April 11, pp 16 and 17.

Wire-on-Time Jobs Total $270,000

To the Editor:

I wish to call your attention to an error in the March 14 issue of Electrical World.

On page 44, the article describing the National Adequate Wiring Conference states that our "Wire on Time" plan has reported 1,110 jobs totaling $70,000. This dollar figure should be $270,000. An analysis of $70,000 for 1,110 jobs would indicate that it is a small-scale operation, whereas the reverse is true.

Frank E. Wiatt
Assistant Manager
Electric Sales Department

Cincinnati Gas & Electric Co,
Cincinnati, Ohio

● A little arithmetic reveals that if the total were $70,000, the average would be only $63, certainly small-scale. With $270,000 total, average is $243.

Cables Exceed 100-150-Kv Range

To the Editor:

Reference is made to the article, "Cable Makers Need Encouragement," by L. I. Komives in Electrical World, March 14, page 46, where it is stated that the highest voltage cables in service in the United States are in the 100-150-kv range.

The Corps of Engineers has, since October, 1952, operated at the Bull Shoals project in Arkansas a high-pressure pipe cable installation at 161 kv. The Air Force also has a 161-kv high-pressure pipe cable in operation at its Arnold Research and Development Center, Tenn.

The Corps of Engineers is currently installing a high-pressure, pipe-type compression cable system at the Garrison project in North Dakota which will operate at 230 kv.

Wm. Whipple
Colonel, Corps of Engineers
Executive, Civil Works

Department of the Army,
Office of the Chief of Engineers,
Washington 25, D. C.

Whom Is Memphis Threatening?

To the Editor:

I note with interest that the City of Memphis is threatening to build a steam plant (EW, Feb. 28, p9). I do not know against whom this threat is directed unless it is the taxpayers of Memphis. I am sure that the taxpayers in the other 47 states will welcome some relief from the burden of subsidizing cheap power for the people of Tennessee.

I would like to see them sell power to the TVA too—at the same rate that they are paying for it now, of course.

E. W. McKnight

503 W. Cameron Avenue
Chapel Hill, N. C.

BIDDLE *Instrument News*

BIDDLE "TTR" SETS SAVE DAYS OF TIME IN TRANSFORMER TESTS

Everywhere Biddle Transformer Turn Ratio Test Sets are performing a unique service in measuring turn ratio in transformers to high precision. By means of the "TTR" Set, transformer problems are analyzed quickly and easily. In many cases, one man with a portable instrument can make an average test in less than 15 minutes wherever the transformer stands. Often, based on fault information supplied by a "TTR" test, the shop can start winding new coils before the transformer is untanked and shipped in. Users also save valuable time making acceptance tests on new transformers. Here are just a few of hundreds of companies who have profitably invested in one or more Biddle "TTR" Sets . . .

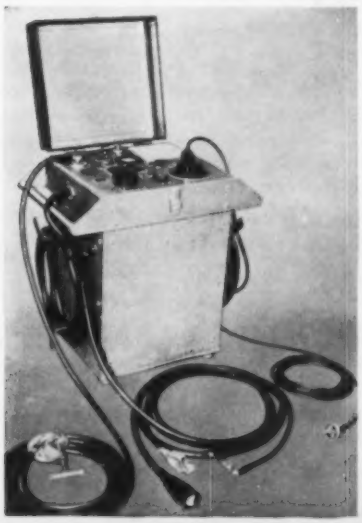
Partial List of "TTR" Users

Westinghouse • Penna. Transformer Co. • Duke Power Co. • Consolidated Edison Co. of New York • Pennsylvania Electric Co. • Detroit Edison Co. • General Electric • Philadelphia Electric Co. • Allis-Chalmers Mfg. Co. • Alabama Power Co. • Oak Ridge National Lab. • Ebasco International Corp. • Metropolitan Edison Co. • Boeing Airplane Co. • Tennessee Valley Authority • Florida Power Corp.

Write for **Bulletin 55-W.**

5 KV TRANSMITTER

BIDDLE IMPULSE CABLE FAULT LOCATING TRANSMITTER Model 5, 5 KV, 16 MUF



Those companies operating an appreciable amount of 600 volt cable should be particularly interested in this recently developed transmitter. Those having cable in the 2500 volt delta and 4000 volt wye insulation class will also find this transmitter well suited to their needs for proof testing and locating faults on important circuits. Similar applications include the proof testing and location of faults in drag cables such as used with electric shovels in strip mines. Still other applications include extensive lighting circuits such as used at airports and in highway lighting.

BIDDLE IMPULSE CABLE FAULT LOCATOR EQUIPMENT NOW INCLUDES:

Model 3, 25 KV, 1.65 MUF
Model 4, 15 KV, 2.00 MUF
Model 5, 5 KV, 16 MUF

Model 2 Detector for use with each of the Transmitters

Model 1 High Voltage Bridge and other accessories

Write for **Bulletin 65-W.**

Biddle Dielectric Test Set Model 1-40 KV

—for measuring d-c current at voltages up to 40 kv when applied to the insulation of such equipment as generators, transformers, bushings and cable.

Carefully considered safety features, excellent output voltage regulation, simple operation, compact design, and facilities for making voltage and current measurements at either polarity have been incorporated in this test set.

The set has a current rating of 25 milliamperes at short circuit, and current measurements can be made down to 0.5 microamperes which is the first division on the microammeter.

Overall dimensions are: height 19½ in., width 13½ in., depth 20 in., weight 120 lbs. All high voltage components are oil immersed.

For complete details, description, specifications, and prices, write for **Bulletin 22-W.**

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.

Gentlemen: Please send me

- ☐ **Bulletin 55-W.**
- ☐ **Bulletin 22-W.**
- ☐ **Bulletin 65-W.**

NAME

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ELECTRICAL TESTING INSTRUMENTS • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT

WASHINGTON COMMENT

What Happened to the Investigations?

- **Four Congressional Committees have indicated an interest in probing utility operations**
- **All four are tied up in other matters or still struggling with organization**
- **Here's an up-to-date report on the status of the threatened investigations**

When the new Congress took over in January, Democrats promised to investigate the entire utilities field. They'd failed to stop the Dixon-Yates power contract in the fall, and they were bursting to get started exposing the "tieup" between the Eisenhower Administration and the private utilities. They waved a lot of fingers and they did a lot of shouting. That is about all to date. But they can't be written off yet.

Here's a rundown on what's happened to the big investigations and the people who promised them:

Magnuson Committee . . . Chairman Warren Magnuson, Washington Democrat, of the Senate Interstate Commerce Committee asked for $200,000 to finance studies this year of the radio-television, transportation, natural gas and electric utilities industries. He also wanted to take a look at the operations of some government regulatory agencies. The Senate gave him the money. Allocated to gas and electric utilities studies is $22,000.

To carry on these investigations, Magnuson borrowed Sidney Davis from the Senate Judiciary Committee. Davis had run Senator William Langer's flashy Dixon-Yates show late last year.

Davis will be some time getting around to a utilities probe. Right now he's up to his knees in radio-TV matters, and that study hasn't even gotten off the ground yet.

Magnuson doesn't have the staff to carry on several large-scale investigations at once; so he's hoping another plan will work. He wants the Federal Power Commission to undertake a sweeping review of the electric utility industry. FPC hasn't done so for a long time, and Magnuson is trying to force the issue with two weapons—he's chairman of the appropriations subcommittee which holds FPC's purse-strings. He's got money now for an investigation of FPC's administration of the law.

Kilgore Committee . . . Davis was replaced on the judiciary committee last week by Joseph W. Burns, a former Justice Department tax-fraud specialist and member of the New York law firm of Fulton, Walter & Halley. Rudolph Halley was counsel in 1951 of the Senate Crime Investigating Committee, headed by Sen Estes Kefauver, Tennessee Democrat. Kefauver is an ardent Tennessee Valley Authority supporter and a foe of privately-owned utilities. He is a member of the judiciary group.

Burns, too, is slated to be bogged down for some time—perhaps till the end of the year—in a study which won't affect utilities. First he and subcommittee Chairman Harley Kilgore will inquire into the attorney general's anti-trust report.

Celler Committee . . . New York Democrat, Rep. Emanuel Celler, is building the house judiciary committee staff. He's just brought in as anti-trust subcommittee counsel Herbert Maletz, former chief counsel of the office of price stabilization and also a graduate of the Justice Department's anti-trust division. Maletz has only been on the job a few days, but his appearance is the first sign that Celler is taking steps to put his anti-trust subcommittee to work.

Celler has promised across-the-board anti-trust studies, including administration of the holding company and securities acts.

Priest Committee . . . Rep. Percy Priest, another Tennessee Democrat and TVA-area congressman, also promised a study of utilities when he took over the chairmanship of the house interstate commerce committee. The logical unit of his group to make such a study is the transportation and communications subcommittee, which is now deeply involved in natural gas pipeline hearings. This will probably delay any Dixon-Yates postmortems or new utilities probes this quarter.

TECHNICAL NOTES

Mechanical advantage of the double-blade center-break switch for adverse weather conditions (ice and wind mostly) may justify its higher cost compared with the long single-blade design for switches rated above 330 kv.

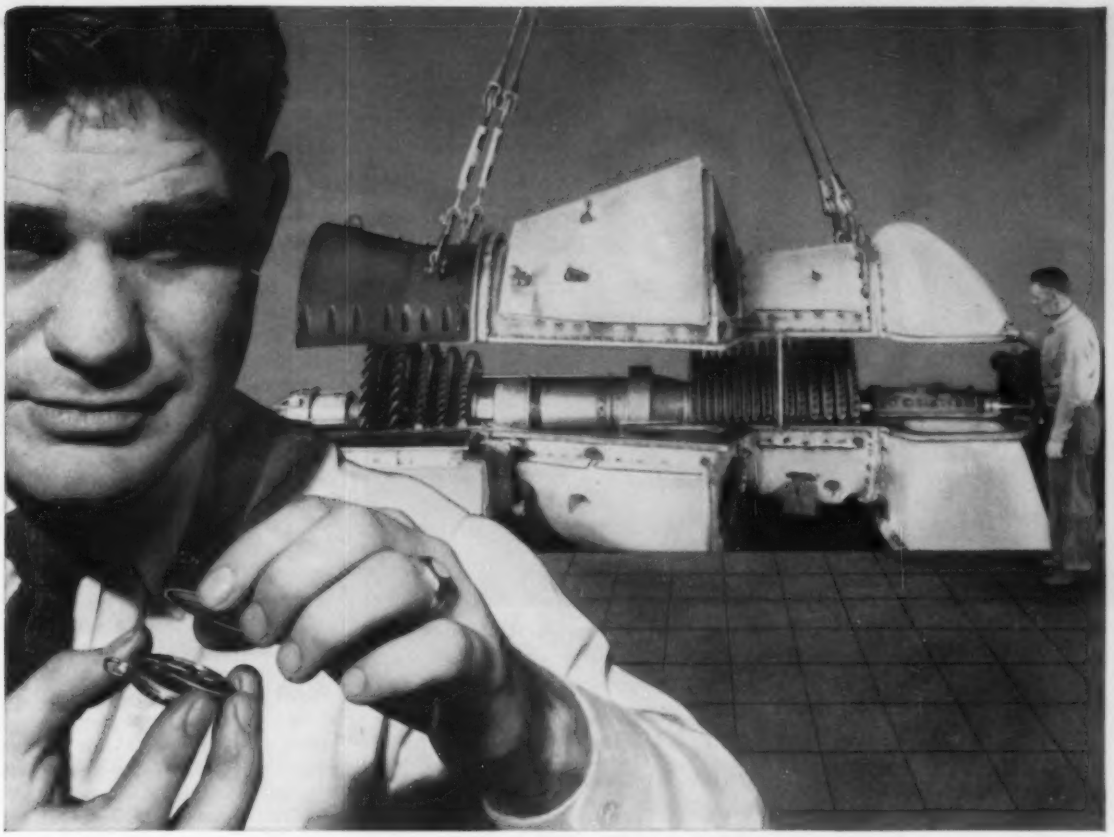
Damming the Mediterranean at Gibralter and the Dardanelles could develop 12,000 Mw from water inflow to replace evaporation losses (Interesting, but a depressing problem to waterfront users.).

Capacitor planning for distribution places them where feeder rearrangements transfer ckva to correct load kvars.

Cheapest major component of power transformers is the most vital. Insulating oil aggregates about $3,000 in a $750,000 modern power transformer.

Store-window lighting can be relieved of glare by adding continuous fluorescent tubes in a protecting handrail on the outside.

Shorter steam connections, savings in building space, and convenient grouping of controls for a pair of turbines can be achieved by placing turbine generators end-to-end with their steam units adjacent.



FACTS on Westinghouse 5000-kw gas turbines . . .

Opens for inspection like a fine watch

Westinghouse gas turbines split down the center line to give you these advantages:

- Turbine and compressor are exposed for inspection and service by lifting one light cover.
- Lifting the cover does not disturb the bearings or the rotor alignment.
- No extra space is needed around the turbine for opening it—the cover is lifted straight up to take it off.

The center-line-split design of Westinghouse gas turbines saves maintenance dollars, saves on lifting equipment and saves building expense. It is the same basic design that has been used on Westinghouse steam turbines for over 50 years because it gives utilities the ease of maintenance they want. It provides the easiest, safest and quickest way to open a turbine.

GET ALL THE FACTS about easy maintenance of a gas turbine. Call *The Man With The Facts,* your Westinghouse sales engineer, or write for a copy of booklet B-5887, *Westinghouse Gas Turbine Power Plants for Electric Power Generation.* Westinghouse Electric Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-50573

GAS TURBINE POWER PLANTS FOR ELECTRIC POWER GENERATION . . . 1250 KW TO 15,000 KW

YOU CAN BE **SURE** . . . IF IT'S

Westinghouse

TRAINING MORE ENGINEERS depends on motivation says C. H. Linder, General Electric, while AIEE President A. C. Monteith listens

APC Reveals Nuclear Plans

(*Continued from page* 105)

college. The greatest single cause of the other 58% not graduating was lack of motivation, not money, as is often assumed. Working with secondary schools to awaken and maintain interest has been effective in the past, he noted.

Plan Ahead for Economy . . . Regional interconnection of power systems was advocated for economy by F. L. Adams, Federal Power Commission. A new 220-kv grid in nine southeastern states could save $62.8-million annually by 1962, largely in pooled reserves and coordinated generation. Estimated cost of the 5,435-mile network built for ultimate conversion to 330-kv operation is $362-million. And annual cost of $40 million, including operating and maintenance, would leave a net savings of nearly $23-million annually.

Operation of interconnected systems becomes complex. Another session of the conference heard reports on the use of computer by the Southern Co Power Pool and by American G&E to factor transmission losses in scheduling generation for lowest incremental cost.

Planning systems for long-range growth likewise received attention. H. L. Melvin, Ebasco Services, proposed these ten steps:

1. Forecast load 10 to 20 years.
2. Plan distribution for future.
3. Select energy supply.
4. Prepare alternate plans.
5. Test other plans on network analyzer.
6. Prepare investment, fix charge, and operating cost estimates.
7. Compare economic and operating merits.
8. Apply experience and managerial judgment to basic program.
9. Make firm decisions for initial projects.
10. Extend the plan periodically.

Long-range planning in Los Angeles is tied to land use surveys, reported E. L. Kanouse and J. W. Reinhard. Applying trends in occupancy and eelctrical usage to unit areas permits forecasting system additions for future usefulness and economy.

Economies in Plant Locations . . . Possibilities for power plant economies start in the first stages of planning and continue until the plant is completed, said P. E. Gourdon, Ebasco Services. While possible dollar gains may appear individually small, the summation of small elements, said Gourdon, can reach several dollars per kw of capacity and many dollars earned on fixed and operating costs.

In a discussion of the Gourdon paper, M. J. Archbold of Commonwealth Edison Co said designs must be simplified and streamlined but it was necessary to guard against over simplification. Each operating position, he said, costs $40,000 a year.

Cooling towers are becoming an economic factor leading to location of steam power plants near load centers, said R. W. Gausmann, Indianapolis P&L. Annual costs must be weighed against transmission losses, plant costs, and coal costs and the costs of other methods of solving the cooling water problem, including plant efficiency, he added.

Industrial Loads Need Study . . . To determine when power should be generated by an industrial plant, careful studies must be made of the particular conditions such as the probable load curve, availability and cost of purchased power, reliability and voltage regulation of purchased power and fuel costs, said M. L. Jones of E.I. duPont de Nemours. Each case must be analyzed and the cost of doing the job both ways must be determined if the best choice is to be made, said Jones.

The series capacitor is often the most economical solution to a serious voltage problem in an industrial plant, T. H. McGreer of Sargent & Lundy, told the industrial session. Series capacitors cancel impedances in industrial distribution and reduce voltage fluctuations. But they must be located with care to prevent undesirable voltage rise, he said.

Thermocouples Installed . . . Thermocouples at various points in the boiler to measure gas and metal temperatures produced test information to guide procedures for the fast starting of 150,000 lb-per-hr industrial boilers, said C. E. Morrow, Western Electric Co. It was possible to place boilers on the line after 60 min of firing if the unit has been off as long as 50 hours, or after 90 minutes of firing if the unit had cooled to room temperature. High excess air is the answer to problems of fast starting, said Morrow.

LONG LIFELINES

Since 1893, Orangeburg has served the Power and Light, Telephone, General Construction, Municipal and Industrial fields. Orangeburg Fibre Conduit's record for giving complete protection to underground electrical cables at minimum cost is well known.

Orangeburg material is impermeable, the joints are watertight – no corrosive ground waters get in. *Smooth bore* reduces pulling tensions on cables to minimum – safeguards the cable sheath from abrasion. Non-metallic Orangeburg does not corrode – resists acids, alkalies, salt, grease, oil. It is lightweight – yet tough, strong and resilient.

Orangeburg is a leader in every city and state. It saves money for users by faster handling, tooling and laying. A complete line of fittings, angle couplings, bend sections, bell ends . . . mean speed of installation . . . prevent costly delays. For more facts write Dept. EW-45B.

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BRANCHES AND STOCKS IN PRINCIPAL CITIES

GENERAL ELECTRIC SUPPLY COMPANY

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FINANCING AND REGULATION

Oregon Bill Calls For Public Power Commission

Authority to issue revenue bonds as well as general obligation bonds of the state of Oregon, and provisions intended to curb excessive valuations on utility property by juries in condemnation suits, are key provisions of a second bill introduced on March 26 in the 1955 legislature to create a state power development commission. As with the earlier bill introduced in the Senate, the new one of Rep Kay Meriwether, Portland Democrat, would implement a 1932 constitutional amendment legalizing such a public power commission.

Mrs Meriwether's proposal is more specific in that it declares that development of Oregon's hydroelectric resources in line with the principles of comprehensive multiple use is a state policy. It provides procedure for condemning privately-owned power facilities, the valuation to be determined by a board of expert appraisers rather than by the jury, and would create a water resources advisory board representing interested state agencies handling fish, game, forests, and agriculture.

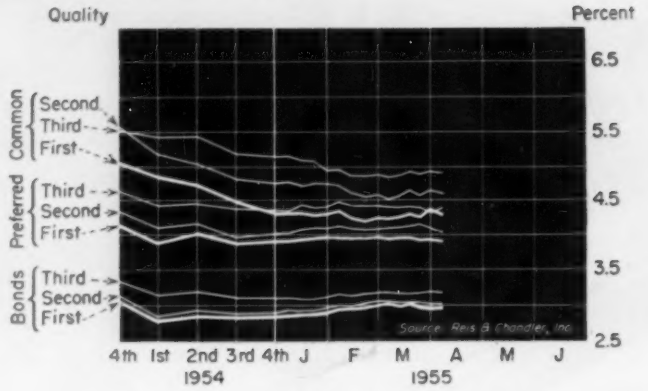
The bill would provide $200,000 for initial administrative expenses and calls for election of three commissioners on non-partisan ballot for six year terms at salaries of $9,000 to $11,000.

Mrs. Meriwether's measure goes a step further in providing that private systems acquired by condemnation be broken up and the commission be required to sell, lease or otherwise dispose of facilities to consumer-controlled local agencies.

FINANCIAL BRIEFS

Tacoma, Wash., Department of Public Utilities will offer $15 million revenue bond issue for public sale in June to finance early stages of its Cowlitz River project . . . **Public Service Co of Indiana** stockholders have voted to increase common shares from five million to eight million and preferred stock from 1,550,000 to 2,000,000 shares.

Today's Utility Yields—(%)



	BONDS			PREFERRED STOCKS			COMMON STOCKS		
QUALITY	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Apr. 7	2.99	3.01	3.18	3.92	4.05	4.39	4.31	4.60	4.91
Mar. 31	2.99	3.02	3.18	3.95	4.09	4.39	4.33	4.64	4.93

Utility Earnings

COMPANY	PERIOD MONTHS ENDED		NET INCOME 1954	NET INCOME 1953	EARNINGS PER COMMON SHARE 1954	EARNINGS PER COMMON SHARE 1953
American Gas & Electric, consolidated	12	Dec.	$36,301,938	$34,479,458	$2.52(a)	$2.49(a)
Florida Power & Light	12	Dec.	10,678,718	8,392,185	3.50	3.07
Idaho Power	12	Dec.	4,818,907	4,502,830	3.60	3.38
Iowa Southern Utilities	12	Dec.	1,201,558	1,341,386	1.44(b)	1.64(b)
Kansas City Power & Light	12	Dec.	7,129,897	6,521,293	2.33(c)	2.42(c)
San Diego Gas & Electric	12	Dec.	5,162,726	4,627,428	1.24(a)	1.30(a)

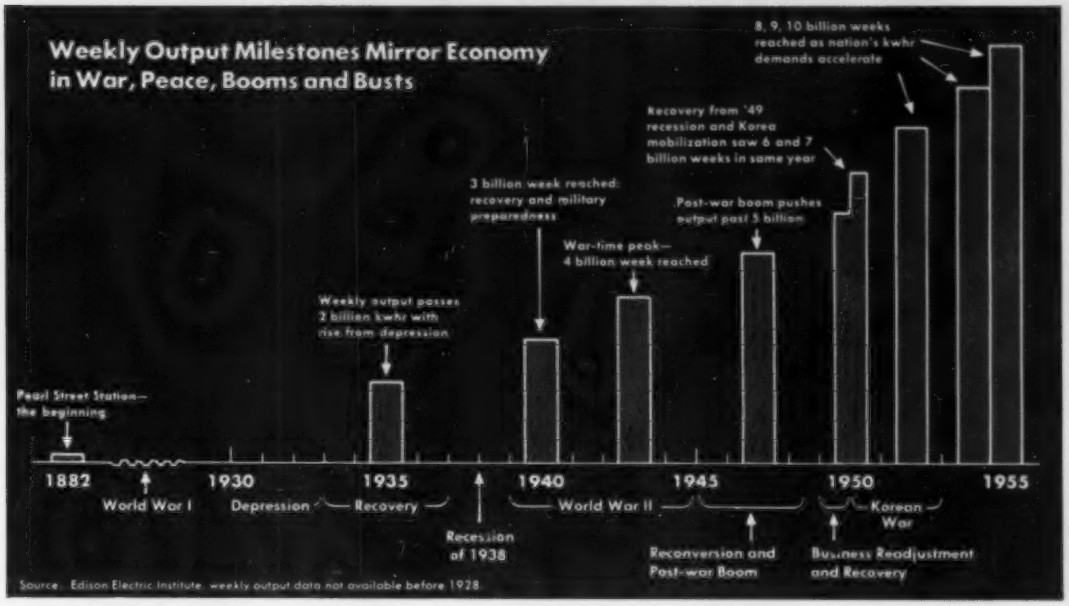
Notes—All figures shown above have been audited. (a) Based on average shares; (b) Based on 745,751 shares in 1954 and 736,005 shares in 1953; and (c) Based on 2,450,000 shares in 1954 and 2,224,540 shares in 1953.

Utility Financing

COMPANY AND DESCRIPTION	AMOUNT OF OFFERING (000)	OFFERING PRICE	YIELD TO PUBLIC
APRIL 7-13			
BONDS			
Central Maine Power—1st mtg 3⅛% due 1985	$12,000	100.849%	3.33%
PREFERRED STOCK			
Public Service Co of Indiana—202,431 sh 4.20% $100 par conv. cum (being offered common stockholders on 1-for-21 basis, record April 13 to expire May 9)	$20,243	$105.00	4.00%
California-Pacific Utilities—50,000 sh 5% cum $20 par.	1,000	26.00	5.00
SCHEDULED FOR APRIL			
BONDS			BID DATE
Philadelphia Electric—1st mtg due 1985	$50,000	.....	April 18
COMMON STOCK			
Savannah Electric & Power—165,000 sh of which 100,000 sh will be sold by Donner Estate and balance by company	.....	.....	April 14 (a)
Western Light & Telephone—87,000 sh (to be offered common holders on 1-for-7 basis, record April 20)	.....	.....	.....(b)

Note—(a) First Boston—Stone & Webster group, underwriters; and (b) Dean Witter & Co group, underwriters.

STATISTICS


Weekly Output Milestones Mirror Economy in War, Peace, Booms and Busts
8, 9, 10 billion weeks reached as nation's kwhr demands accelerate
Recovery from '49 recession and Korea mobilization saw 6 and 7 billion weeks in same year
3 billion week reached: recovery and military preparedness
Post-war boom pushes output past 5 billion
War-time peak— 4 billion week reached
Weekly output passes 2 billion kwhr with rise from depression
Pearl Street Station— the beginning
1882
1930
1935
1940
1945
1950
1955
World War I
Depression
Recovery
Recession of 1938
World War II
Reconversion and Post-war Boom
Korean War
Business Readjustment and Recovery
Source: Edison Electric Institute. weekly output data not available before 1928

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Feb.	103.74	103.62	92.46	12.2
Peak—Class I Systems (million kw)	Jan.	84.1	85.5	78.0	7.9
Estimated Dec. '55 Peak (million kw)	Jan.	95.7	95.9	96.8	−1.1
Production—billion kwhr	Jan.	43.96	43.43	39.42	11.5
hydro		9.43	9.05	8.90	6.0
fuel		34.53	34.38	30.52	13.1
Sales—billion kwhr	Dec.	35.25	33.87	32.31	9.3
residential		11.15	10.07	9.77	14.0
commercial		6.22	6.14	5.60	8.5
industrial		15.57	15.38	14.83	6.8
other		2.30	2.29	2.12	7.5
Fuel Consumption	Jan.				
coal—million tons		12.02	11.90	10.92	10.1
oil—million barrels		8.91	7.67	8.29	7.6
gas—billion cu ft		65.13	74.93	67.41	−3.4
Net Income Class A & B Co's—$ million	Dec.	109.05	94.91	100.86	8.1
Residential Customers—millions	Dec.	43.14	43.04	41.98	2.8
revenue per kwhr		2.69¢	2.70¢	2.74¢	−1.8
avg. kwhr per customer		2,549	2,528	2,346	8.7
avg. annual bill		$68.57	$68.26	$64.28	6.7

Business Statistics . . .

Indexes: 1947 − 49 = 100					
FRB Industrial Production	Feb.	135	131	126	7.1
ENR Construction Cost	Mar.	135.4	135.1	128.7	5.2
BLS Cost of Living	Feb.	114.3	114.3	115.0	−0.6
NEMA Sales	Feb.				
insulation materials		137	132	120	14.2
electric appliances		118	118	98	20.4
household refrigerators		94	96	91	3.3
Wholesale Prices	Feb.				
motors and generators		121.2	121.6	124.3	−2.5
transformers and regulators		127.8	128.1	128.1	−0.2
switchgear and fuses		135.4	135.3	135.1	0.2
GNP—annual rate—$ billion	4th Qtr.	362.0	355.5	360.5	0.4

Cole Electric Co.

8439 Steller Drive TExas 0-4701 Culver City, Calif.

AIR BREAK DISCONNECTING SWITCH
34,500 volts — 600 amperes — Type O-2
Vertical break. Three pole. Single throw. Group operated.
One pole shown.
SILVER TO SILVER CONTACTS

110v UP TO 330,000v

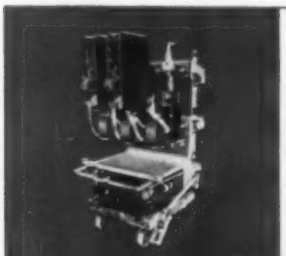
THAT'S FEDERAL PACIFIC TODAY!

FOR YEARS NOW, Federal Noark® devices for control and distribution of low voltage electrical energy have enjoyed a sales growth unprecedented in the industry. Many of these devices—safety switches, molded-case breakers (including epoch-making Stab-lok®), fusible service equipment, switchboards, industrial controls, etc.—have featured improvements of top value to wholesalers, contractors, and users alike.

And today, through amalgamation of many companies, Federal Pacific brings you similar outstanding advantages in new lines of assembled switchgear *plus* a line of high voltage outdoor switchgear whose unsurpassed merit is recognized by utilities throughout this country and abroad.

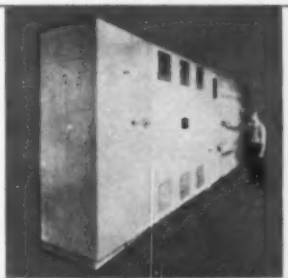
From now on, assure yourself the best in engineering and performance . . . specify Federal Pacific equipment all the way from 110v right up to 330,000v! Ten plants from coast-to-coast spell fast service, too!

THEY'RE NEW—THEY'RE FEDERAL PACIFIC



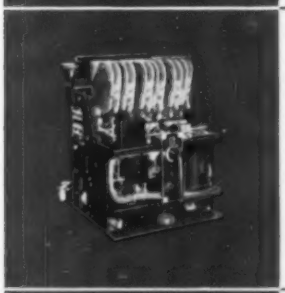
HIGH-VOLTAGE METAL-CLAD DRAWOUT SWITCHGEAR

This is a DST Magnetic Air Circuit Breaker—the heart of Federal Pacific Metal-Clad drawout switchgear. Available in both 5 kv and 15 kv ratings, these breakers are housed in individual, free-standing enclosures, bolted into a complete switchgear assembly. All units are wired, adjusted, and given an operational test at the factory. Indoor and outdoor enclosures.



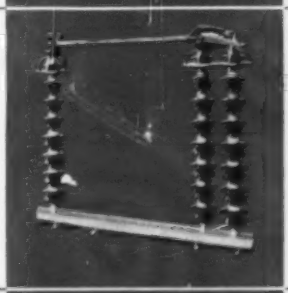
UNIT SUBSTATIONS

Federal Pacific Unit Substations provide a coordinated installation of high-voltage entrance and protective equipment, transformer, and switchgear . . . 5 kv and 15 kv primary and 600v secondary substations available for indoor and outdoor service.



LOW-VOLTAGE METAL-ENCLOSED DRAWOUT SWITCHGEAR

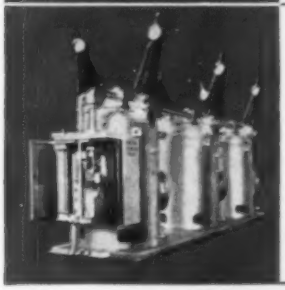
Type DMB drawout air circuit breakers are the protective devices of Federal Pacific Low-Voltage Switchgear. Complete in range from 15,000 through 100,000 amperes interrupting ratings, these breakers are housed in standardized sections that lower installation costs and minimize delivery time.



AIR BREAK DISCONNECTING SWITCHES

Federal Pacific complete line of outdoor disconnecting switches includes both group-operated and hook-operated designs.

Group-operated, vertical-break switches range from 7.5 kv up through 330 kv (illustrated); side-break switches available from 7.5 to 115 kv ratings.



OUTDOOR OIL CIRCUIT BREAKERS

Federal Pacific Oil Circuit Breakers range from 50 mva at 7.2 kv, to 25,000 mva at 330 kv. This complete line is the outgrowth of 50 years' experience on some of the world's largest high-voltage distribution systems.

TRANSFORMERS

Transformers—both liquid and air-cooled—are available in a range through 69 kv. The line includes oil-immersed distribution and power transformers; auto, subway, and dry-type transformers; and several specialty groups such as for neon signs.

Federal Noark

FEDERAL PACIFIC ELECTRIC CO.

FORMERLY—FEDERAL ELECTRIC PRODUCTS COMPANY AND PACIFIC ELECTRIC MANUFACTURING CORP.

Main Office: 50 PARIS STREET, NEWARK 1, N. J.

Federal Pacific products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct, High voltage circuit breakers and power switches ★ Sales offices in principal cities.

KUHLMAN BALANCED DESIGN PROVIDES A COORDINATED CORRELATION OF ALL DISTRIBUTION TRANSFORMER COMPONENTS

CORE BALANCE (1)—The Bent Iron Core achieves the most desirable relation between the transformer, no load loss, and exciting current. It is the most efficient magnetic circuit in use today in distribution transformers.

COIL BALANCE (2)—A core of minimum cross section permits a more efficient use of copper in the coil windings.

INSULATION BALANCE (3)—Insulation between the turns, layers, and from windings to core and case are proportioned to the dielectric stresses encountered in service.

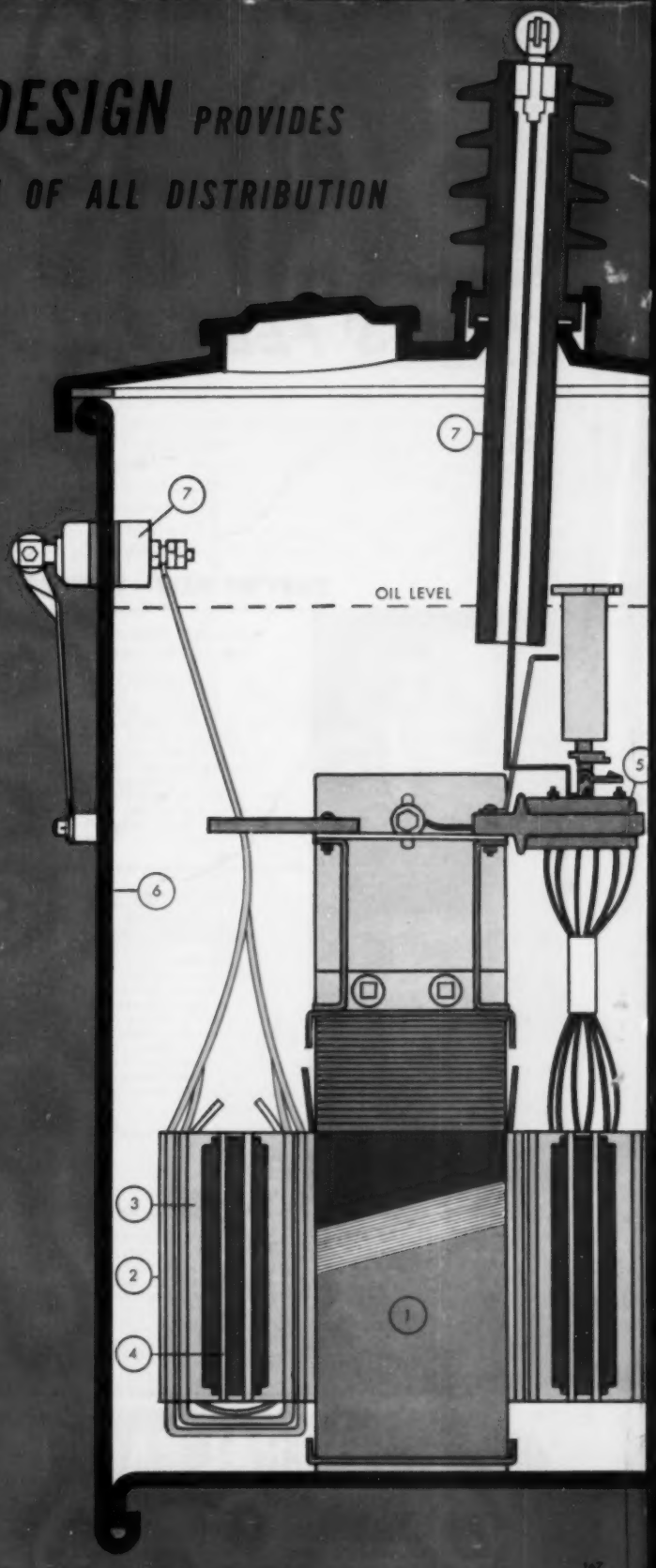
THERMAL BALANCE (4)—Coil structure makes efficient use of ducts and radiating surfaces for cool operation.

TAP CHANGER BALANCE (5)—Ease of operation and firm positive contacts are balanced against adequate insulation strength.

TANK BALANCE (6)—The tank's two functions as a container and a heat dissipator are balanced to obtain adequate radiation with minimum overall dimensions.

BUSHING BALANCE (7)—Flash-over, creepage, and puncture strength are coordinated with winding insulation.

"Balanced Design" in Kuhlman Transformers results in balanced performance of high efficiency and low voltage regulation.



KUHLMAN

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